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A Summary of Current Program, 9/1/65  
and Preliminary Report of Progress  
for 9/1/64 to 9/1/65

FARM PRODUCTION ECONOMICS DIVISION

of the

ECONOMIC RESEARCH SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE

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This progress report is primarily a tool for use of scientists and administrators in program coordination, development and evaluation; and for use of advisory committees in program review and development of recommendations for future research programs.

The summaries of progress on USDA and cooperative research include some tentative results that have not been tested sufficiently to justify general release. Such findings, when adequately confirmed, will be released promptly through established channels. Because of this, the report is not intended for publication and should not be referred to in literature citations. Copies are distributed only to members of Department staff, advisory committee members and others having a special interest in the development of public agricultural research programs.

This report also includes a list of publications reporting results of USDA and cooperative research issued between September 1, 1964, and September 1, 1965. Current agricultural research findings are also published in the ERS publications The Farm Index, a monthly, and Agricultural Economics Research, a quarterly. This progress report was compiled in the Farm Production Economics Division, Economic Research Service, U. S. Department of Agriculture, Washington, D. C. 20250.

UNITED STATES DEPARTMENT OF AGRICULTURE  
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## INTRODUCTION

Farm production economics research, as used in this report, deals with many and varied economic problems of agricultural production. The work is concerned with the economics of organization and management of farms, use of capital and labor in agriculture, production and conservation practices, adjustments in production and resource use, farm financial problems of credit and insurance, and appraisal of alternative production policies and programs.

Rapid technological change in agriculture and the tendency for farm production to outstrip growing demands for products gives rise to continued need for economic adjustments in our farm economy. Farms are decreasing in number and increasing in size and degree of specialization. Farm machinery, fertilizers, and other innovations, are substituting for land and labor. Coupled with rising farmland values, these developments necessitate large and increasing capital investments per farm, and alter farm credit and insurance needs. Increasing dependence on purchased inputs and on cash markets for products make net income increasingly vulnerable to changes in prices of both inputs and outputs. These trends challenge the most rigorous research in the field of farm economics. Results of research in this field are widely used as aids in management and policy decisions at the farm, area, regional, State, and national levels.

The Department's program of research and related statistical reporting in farm production economics is conducted from headquarters in Washington, D. C., and is concerned chiefly with problems of regional and national scope. Field studies generally are conducted in cooperation with State experiment stations. When studies are made jointly by Federal and State workers, Federal people usually are most interested in regional and national applications of results, while State workers are most often interested in local applications. Close working relationships between Federal and State agencies have long been traditional in this field. This close cooperation in planning and conducting the work reflects joint and cooperative efforts rather than overlapping or duplication of effort.

The farm production economics research program is covered under 9 area headings shown in the Table of Contents. More detailed subject-matter subheadings are given in the discussion of each area of work.



During the year covered by this report, the special policy and program contributions that the Division has been able to make have been significant. Division personnel have responded to many requests for assistance from the Office of the Secretary, program administrators, the National Agricultural Advisory Commission, and others. In addition, many of the Division's continuing statistical series and analyses have become increasingly important in efforts to understand changes and achieve improvements in the structure and in the well being of American agriculture.

Some illustrative examples of Division research contributions during the reporting period follow.

Economies of Size in Farming. Intensive studies of selected farm types indicate that most of the economies attributed to size of business on the types studied to date are attainable by "medium sized" units. These efficient medium sizes include a 440-acre cotton farm in the Texas High Plains, a 600-acre cotton farm in Fresno County, California, a 45-cow dairy farm in Minnesota, and a 1,500-head beef-fattening enterprise in Colorado. All can be managed and operated as family-type farms. On all, unit costs are nearly as low as, and in some cases slightly lower than, for any larger size. Larger sizes are little if any more efficient, but their larger volume leads to considerably greater profit. Study results suggest, however, that the attraction of higher profits offered by expansion to very large sizes often results in added risk and difficulty of coordination. This may help to explain the coexistence of large and small farms. Intensive studies of more farm types are currently underway.

Influences of Weather and Technology on Corn Yields. In order to make possible the separation of the influence of weather and technology on changes in corn yields, weather indexes have been developed for the Corn Belt. Corn yields in the Corn Belt more than doubled from 1929 to 1962. In 1929 the actual corn yield was 34 bushels compared to 77 in 1962. After adjusting these yields for the influence of weather, yields of 29 and 73 bushels would have been expected with normal weather. While variability in weather affected yields for short periods within this longer period, its effect for the entire period was negligible. Corn yields moved up each time Corn Belt farmers began using a new production technique. When the technique became widespread, yields hit a plateau until the next innovation started to make an impact. The adoption of hybrid seed pushed yields up steadily from 1933 until 1948, when 99 per cent of the corn planted by Corn Belt farmers was hybrid. Yields remained on a plateau until the middle 1950's. Increased use of nitrogen fertilizer raised yields to a new plateau by 1956. Plant population per acre started to increase about this time. However, the additional fertilizer required for these stepped-up plant populations did not come along until



about 1961 when yields once again increased. While raising the average level of corn yields, technological advances have ironed out some of the variations in yields. In years of bad weather yields do not decline proportionately as much as 30 years ago, but in years of good weather they do not increase as much either. Thus, barring extreme weather conditions, weather variability is not as important a factor for increasing yields now as it was in earlier years.

Appraisal of Cotton Production Costs. Major studies are underway on the measurement of annual changes in the cost of producing cotton and on means of reducing production costs. A beltwide survey of 5,200 cotton producers has been completed and the resulting data are now being processed. These data are intended to fulfill the provision in the Agricultural Act of 1964 (PL 88-297) that the Secretary of Agriculture consider, among other factors, the cost of producing cotton in setting price support levels for cotton. Research is being expanded on the economic effects of changing technology in cotton production, with emphasis on means of reducing production costs. Cooperative research on cost reduction has been initiated with the Georgia, South Carolina, and Tennessee Agricultural Experiment Stations; other States will be included. Cooperative work has been initiated with the Louisiana, South Carolina, and California Stations on special studies of land values and prices, with emphasis on alternative methods of estimating an appropriate land charge for cotton production.

New Project to Estimate Farmers' Aggregate Production Response. Crucial policy questions recur constantly which need systematic economic analysis. These include such questions as: What changes would occur in the total production of major U. S. commodities next year and the year after under alternative Government programs? How would those changes affect resource use and farm incomes? To help answer such policy questions through research, a "national econometric model" is being constructed for commercial U. S. agriculture. The goal is to estimate farmers' most likely production response to changes in prices, technology, resource availability, and Government programs. Results will be provided by region and type or size of farm as well as for the Nation as a whole. The model now includes 90 farming situations in 46 producing areas that account for the bulk of our cotton, wheat, feed grain, and soybean production. This research represents an attempt to tie together, and to make more predictive, the many pieces of farm adjustment research heretofore applicable only to more local or more limited problems. Data are now being processed for a 1960-64 test of the model's predictive reliability. Plans are to make technical improvements, expand the coverage of commodities and farming situations, and update the production data annually, thereby permitting timely application of the model to important adjustment and policy questions.

Economics of Pesticide Use in Agriculture. The Division initiated a new program of research on the economics of pesticide use in agriculture as part of the Department's expanded pesticide research program provided for by the Congress. The Division's program comprises: (a) A Nationwide farm survey to obtain basic data on costs and practices used to control plant and animal pests; (b) economic analysis of selected alternative methods of pest control on farms with emphasis on control innovations; and (c) analysis of the aggregate economic implications of alternative control methods for agriculture as a whole. The Nationwide survey has been completed. Information on pesticide use and pest control practices, farm characteristics, crop and livestock production, and labor use was obtained in 11,384 detailed questionnaires from commercial farms in 417 counties in 47 States. In addition, limited information on pesticide use and farm characteristics was obtained on about 23,000 noncommercial farms. About 8,000 pesticide products were coded, each identified by form and type of pesticide and the percentage of each active ingredient. The data are now being processed. In the analysis of alternative pest control methods on farms, two studies were initiated in cooperation with the State Agricultural Experiment Stations of Nebraska and California; a third study will begin shortly in cooperation with the Michigan Station.

AREA NO. 1. AGRICULTURAL ADJUSTMENTS, PRODUCTION  
RESPONSE AND FARM PROGRAM APPRAISAL

Problem. A chronic major problem in agriculture is to adjust production, both in the aggregate and for major commodities, to market outlet. Achievement of economic balance in agriculture and adequate returns to farmers is likely to be especially difficult over the next five to ten years because the capacity of agriculture to produce apparently will more than keep pace with the food and fiber requirements of the anticipated larger population. Some resources now used in overexpanded lines of production need to be shifted or be more efficiently used. Individual farmers can reduce costs per unit of product by reorganizing farm enterprises, adopting improved technology, and increasing the size of their farms. But when many farmers do this, total output mounts and the problem of bringing total supply in line with total demand is intensified. Thus adjustment opportunities cannot be considered solely from the viewpoint of the individual farmer. National and regional aggregate production response are important in considering the farm adjustment problem. Analyses of profitable adjustments on representative farms and estimates of both the aggregate output that would be forthcoming if all farms were efficiently organized and operated, and the aggregate response that farmers would be expected to make, are needed as a basis for evaluating the adjustments that would be profitable both to individual farmers and to the industry under different economic situations, and for appraising the effects of alternative farm adjustment programs. Continuing analysis of trends in farm output and resource productivity is also needed to measure changes in the farm situation.

USDA AND COOPERATIVE PROGRAM

The program encompasses four major types of work. Studies of national and regional productivity conducted in Washington, D. C. analyze the factors responsible for changes in total output and resource productivity for the Nation and for 10 broad farm production regions. These studies become the basis for long-term projections of prospective trends in farm output and productivity, in numbers of farms, and in other major characteristics of the Nation's agriculture. Studies of production response and needs for adjustment are conducted in Washington, D. C. and at several field locations. These studies emphasize the methodological developments required to appraise the production response farmers are likely to make individually and in the aggregate to changes in technology, prices, programs, and other factors. Attention is also given to the optimum (least cost) regional distribution of crop and livestock production. Area adjustment studies in dairy, cotton, wheat, rice and feed-livestock areas emphasize the determination of the most profitable adjustments for representative farms to alternative combinations of prices. The most profitable organizations weighted by the proportion of the population represented by each



typical farm provide first approximations of the area implications of individual farm adjustments. These studies are conducted in cooperation with 15 State agricultural experiment stations in dairy areas, 12 in cotton areas, 10 in wheat areas, and 22 in feed-livestock areas. Studies of adjustment opportunities in rice areas are conducted in Arkansas, Louisiana, Mississippi, and Texas. Studies of agricultural policies and program appraisals are oriented toward an understanding of the impacts and means of improving programs and policies at the national level, including the acreage allotment programs, wheat programs, the probable effects of alternative sugar quota and pricing policies, prospective use of land released from the Conservation Reserve, and impacts of the current feed grain program. This work involved formal cooperation with 12 State experiment stations.

A total of 63.5 Federal professional man-years are devoted to this area of work: 4.9 man-years to national and regional productivity in agriculture; 17.8 man-years to appraisal of production response and needs for adjustment including 0.6 on a research contract with the University of Wisconsin to develop an improved model for explaining aggregate production response; 5.1 man-years to appraisal of adjustments in dairy areas; 9.9 man-years to adjustments in cotton areas; 5.6 man-years to adjustments in wheat areas; 3.7 man-years to adjustments in rice areas; 10.9 man-years to adjustments in feed-livestock areas; 2.6 man-years to appraisals of agricultural policies and programs; and 3.0 man-years to cotton cost analysis.

#### PROGRAM OF STATE EXPERIMENT STATIONS

Practically all State experiment stations have research under way dealing with long-range trends and adjustments in agriculture relative to current and prospective changes in economic and technological conditions and institutional factors such as farm programs. These studies involve the analysis of profitable adjustments on representative farms and the most likely aggregate production response for a given area, industry, State or region when farmers reorganize resources in an optimum manner. These studies also consider the changes in the numbers, types, sizes, and location of farms, the competitive position of regional agricultural industries and the demand for land, labor, and capital used in agricultural production. Adjustment research is oriented towards the major production areas of dairy, cotton, wheat, rice, feed grains, and livestock.

A considerable segment of adjustment work is conducted as cooperative regional research between the State experiment stations and USDA. This type of research is presently under way in each of the four major regions. Studies in the Northeast are primarily concerned with dairy adjustment needs and opportunities at both the farm and industry levels to meet changing economic and technological conditions. Research in the Southern region deals with an appraisal of farming adjustment opportunities and the level of farm resources required to meet specified income targets. These studies are investigating the alternatives available for the profitable use of land and other resources which were traditionally committed to

cotton production. Research in the North Central region will estimate the supply responses for hog and beef cattle and investigate related structural adjustments within the agricultural industry. The recently revised regional study in the West will determine individual farm adjustments and supply responses to various price relationships and other factors. The subsequent phases of research will measure aggregate adjustments and supply responses for each major commodity produced in the region. A move is under way to improve the comparability of data between regional groups and to develop methodology for the measurement of national aggregate resource organization and production response.

Several States and USDA are engaged in an interregional cooperative effort to examine the effects of selected farm programs on the use of resources in agriculture, the levels and structure of output, the level and distribution of income, the formation and distribution of capital, and the relationship of these programs to the general growth of the economy.

In addition to the cooperative research effort the stations are conducting independent studies in this area of work. Research in the North Central region is concerned with the relationship of various farm programs to farm production, income, and resource use. The costs of farm programs to the taxpayer and their impact on the economy of local communities are also being considered. Studies in the Northeast deal with the current and prospective effects of farm price programs on the competitive position and income of the regions' agriculture. In the South research is under way to determine the effects of production control and allotment programs on farming adjustment opportunities. The enterprises being considered are dairy, poultry, swine, beef, peanuts, and tobacco. Research investigations in the Western region deal with the effects of agricultural programs on the farm firm and on the structure of the agricultural industry. Other studies are analyzing the effects of market orders on the production, marketing, and prices of fruits and vegetables. The total State effort devoted to this area of research is 100 professional man-years.

#### PROGRESS -- USDA AND COOPERATIVE PROGRAM

##### A. National and Regional Productivity in Agriculture

Preliminary estimates of total farm output in 1965 indicate that it will be the highest of record, 17 percent above the 1957-59 average and 5 percent above the 1964 output. Livestock production indicates a reduction of one percent, the first reduction in five years. Dairy production will equal last year's record, while poultry production in 1965 is the highest of record. Meat animal production will be down because of a reduction in hog production. Crop production in 1965 is 7 percent larger than in 1964, and 4 percent larger than the previous record in 1963. Feed grains are up 16 percent due to record yields for each feed grain. Food grain production is expected to be 5 percent greater than last year. A record soybean production--24 percent larger than last year's high--led to an increase in oil crop production of 22 percent.



Total inputs in 1965 are estimated to be at a record high, 5 percent above the 1957-59 average and 1 percent above 1964. The productivity of inputs is as great as the record set in 1963. Farmers continue to increase their purchases of nonfarm inputs. The volume of fertilizer and liming materials purchased in 1965 increased 10 percent from 1964, and is nearly three-fourths greater than the average in 1957-59. Stepped-up purchases of feed increased the feed, seed, and livestock purchases nearly 3 percent. Chemicals for controlling weeds and insects continue the rapid upward movement of recent years. Land and service buildings have remained about constant for over a decade. On the other hand, labor has continued to decline, partially offsetting the nonfarm input purchases. In 1965, labor is estimated to decline but at a considerably slower pace than in recent years.

An econometric analysis continues on aggregate resource adjustments in U. S. agriculture. Input elasticities and production functions were estimated for five periods since 1910. Least-cost input combinations for the 1952-61 period, assuming equilibrium output was 90 percent of actual output, involved significant changes in input use: Labor reduced by 55 percent, machinery increased by 15 percent, real estate increased by 56 percent, and fuel and other operating expense increased by 21 percent. The large increase in real estate seems contrary to output reduction, but less intensive land use is consistent with cost reduction. The least-cost combination would result in an estimated annual savings to farmers of \$4.2 billion. An econometric model also has been developed which will trace the effect of changes in selected input variables on total production. Two papers have been approved and are in the process of publication.

A manuscript on the effects of weather on corn yields in the Corn Belt has been published. Barring extreme weather conditions, improved technology has reduced the relative variations in corn yields. Thus, with the same weather conditions as, say, 3 decades ago, we now expect less annual variation in crop yields.

Reappraisals of prospective increases in crop yields indicate that average yields may exceed 82 bushels of corn, 605 pounds of cotton lint, and 4,700 pounds of rice by 1970.

A manuscript on the appraisal of prospective improvements in feed conversion rates and the total feed use in poultry production is being written. Already published as background material for the above report, is a study of technology in broiler production and its impact on feed conversion and marketing weights. The average weight of broilers has increased from 3.1 pounds liveweight in 1955 to 3.4 pounds in 1964. Technological change has materially lessened the relative cost disadvantage of heavier broilers, as feed conversion rates are now maintained into heavier weights. Changing technology has shifted the advantage towards bigger birds even with the lower broiler-feed ratios that have occurred in recent years. Narrowing profit margins and rising wage rates have made processing costs a factor of increasing importance. It costs about the same to process a heavy



broiler as a light one, but significantly less per pound. This pressure to reduce processing costs has further contributed to the shift towards heavier birds.

#### B. Appraisal of Production Response and Needs for Adjustment

Research has centered on the development of a national econometric model for production adjustment research and policy guidance, a project initiated last year. The national model ties together regional and farm analyses into an integrated national framework for estimating changes in the production of major farm commodities, in associated resource use, and in other factors. Current emphasis is on "predicting" farmers' production response to changes in prices, costs, Government programs, technology, and resource availability. About 90 farming situations in 45 geographic regions are included in the model.

These farming situations account for the following percentages of total U. S. production: Cotton--87 percent; corn--90 percent; wheat--83 percent; grain sorghum--81 percent; soybeans--91 percent; and barley--69 percent. Data required for a 1960-1964 test of the model have been compiled, and computational work is underway.

Work was completed on a related study of interregional competition in U. S. livestock and crop production, in cooperation with Iowa State University. This study is one in a series aimed at measuring the adjustments that would be necessary if U. S. supplies were produced with maximum economic efficiency and if those supplies were in balance with demand. The analysis includes 157 crop-producing areas and 20 livestock-producing areas. Enterprises are feed grains, wheat, soybeans, cotton, hay, pasture, grain fattened cattle, other beef cattle, dairy cattle, and hogs. The production pattern and marketing flows for 1954 are compared with those for 1965. Detailed results show effects of the continuing expansion of U. S. productive capacity at a rate faster than the increase in demand for agricultural products. The study is reported in an unpublished Iowa State Ph. D. thesis, "Interregional Competition in Livestock and Crop Production in the United States: An Application of Spatial Linear Programming."

One study was continued and another initiated to develop criteria for defining representative farms or resource situations as units of analysis in studies of aggregate production response, and to measure the differences in aggregate supply estimates obtained using different numbers of units. The continued study (in cooperation with Iowa State University) uses data from the NC-54 cooperative regional project to derive aggregate Iowa supply functions for hogs and beef. Thirty-six representative farms are defined on the basis of crop yields, labor use, and the proportionality of farm resources. The resulting aggregate supply functions will be compared with those based on progressively smaller numbers of representative farms to measure the relation between numbers used and the accuracy of total supply estimates. The new study will develop and test procedures for

defining representative farms in the Southeast cotton region, with emphasis on techniques to account for the effects of annual changes in farm characteristics.

### C. Appraisal of Adjustments in Dairy Areas

Work continued on the Northeast dairy adjustment study with active cooperation of 10 States. Representative farm situations were selected from survey data. They were developed by a method designed to minimize aggregation bias which was developed by members of the Northeast Dairy Adjustments Study group. Stepped milk supply functions were programmed for several of the twenty areas in the Northeast. These supply functions represent the normative milk supply response of the resource base of 1961 using the technology of the upper 25 percent of the farmers. Preliminary estimates of demand by area have been made for both fluid milk and manufacturing milk. Supply and demand basing points have been calculated for each of the 20 areas in the Northeast. When supply, demand and transportation costs are combined in a quadratic model, they will yield a spatial equilibrium solution of production, distribution, and price for fluid and manufacturing milk.

The linear programming models developed for use in this study have been used to develop other aspects of dairy adjustments in the Northeast. For example, they provided the basis for evaluating the impact of various milk quota systems on both total supply of milk and economic impact on dairy farms. A series of linear programming solutions were obtained for three different representative farms. These farms represent the classes of dairy farms that are either labor, land, or capital restrictive. Two Class I prices were used to represent a high price and a low price market, and two different utilizations of Class I milk were assumed. These solutions bracket the range of prices and utilizations which might be found in any of the Northeastern markets. A result of this analysis is that for all farm resource situations and all market price and utilization conditions, the imposition of a Class I quota program would automatically reduce total supply of milk and at the same time increase the net returns to producers.

A further use of the models developed for the Northeast Dairy Adjustment Study has been the analysis of optimum organizations, net incomes, and resource valuations as related to differences in qualities and quantities of cropland and dairy cows. A draft has been written of a bulletin relating optimum organizations, net incomes, and resource valuations to these differences in relative quantities and qualities of cropland and dairy cows. The study area of this bulletin is in southern Maine and New Hampshire.

In the Lake States, progress with the linear programming and regional aggregative equilibrium analysis has been reported in previous annual reports. Work has continued on special problems in each of the three States.



In Minnesota, the alternatives of further specialization in dairying or expanding the hog and cash crop enterprises on farms producing Grade A milk were assessed. Another phase of the analysis utilizes data from a producer panel to provide an improved basis for estimating changes in the structure of farming generally and expected changes in dairy cow numbers and milk production particularly. Among the variables correlated with changes in dairy production are initial size of the dairy herd, willingness to borrow money to expand production, ratio of total assets to total liabilities, long-run price expectations for dairy products, age of farm operator, extent of off-farm employment, and dairy capacity. A manuscript, "Use of a Producer Panel to Estimate Agricultural Structure and Supply," is being reviewed for publication.

In Michigan, an inclusive analysis of the inter-firm, inter-farm type and inter-area results of the programming study was completed and published. Additional computations were made using Class I base pricing alternatives for milk in the linear programming model. The results were published in a report "Milk Production Allotment and Class I Base Plans--Effects on Michigan Dairy Farms." The expanded programming model was used to evaluate proposed dairy legislation. A minimum cost model was used to allocate assumed product demands among types of farms by geographic areas of Michigan. It includes specifications of drained and undrained cropland and pastureland by soil management class to measure the potentials of upgrading land by drainage.

A study of Wisconsin dairy farms with 40 to 110 cows was completed, which shows how costs and returns change as output and herd size increase. High production per cow and larger than present average herd sizes are profitable and possible on family farms with modern housing, feeding, and milking facilities. Farms with 40 cows and 12,000 pounds milk per cow can earn a return of 5 percent to capital and \$4,000 a year to the operator when the net price of milk is \$3.50 per hundredweight after hauling. Net returns to operator increase rapidly as herd size or production increases. A manuscript "Costs and Returns for Large Wisconsin Dairy Farms" is in process of publication. The study indicates that dairy farmers will continue to expand and modernize their facilities not only to obtain a reasonable return but also to lighten their workload and have an occasional day away from the farm. A 2-man unit can economically utilize the high investment necessary for modern, expanded facilities. Studies in dairy adjustments to changing conditions and technology are being continued in a sub-project which investigates alternative methods of harvesting and feeding forage. The three types of forage handling systems are chopped hay, baled hay and low moisture silage.

#### D. Appraisal of Adjustments in Cotton Areas

During the year emphasis in cotton adjustment work has been on development of optimum organizations for representative farms and associated aggregates of production, labor, annual operating capital and returns under alternative

allotment level product-price combinations for major cotton-producing areas.

These aggregates, assuming alternative allotment levels, are now being concentrated at a single location for purposes of combining them into aggregates for the entire Southern region. They will then be subjected to analysis and a report prepared.

In the first phase of this study aggregates were prepared for the Southern region under the assumed conditions that no allotments would be in effect. A report covering these results "Cotton--Supply, Demand, and Farm Resource Use" is being reviewed by the Technical Committee for Cooperative Regional Research Project S-42. Among other things, this report indicates that with a cotton price of 20 cents per pound the 17 study areas would produce about 9.8 million bales under the assumed conditions. With 25-cent cotton, the study area would produce 25.8 million bales. If these production figures are expanded to include areas not covered in the study, U. S. cotton production would be 12 million bales at 20 cents and 31.9 million bales at 25 cents. Production and offtake of cotton would come into equilibrium at about 22 cents per pound. This price would bring forth a crop of about 22 million bales.

In a third phase of this study, the impact of changes in the prices of selected factors of production on the minimum land requirements is estimated for specified levels of income under alternative allotment level product-price combinations. Some preliminary programming under this objective has been done in several cotton-producing areas.

A study directed toward the refinement of technical coefficients for use in programming optimum organizations in the Delta of Louisiana is now in its second year. Detailed information is being collected on the soil-technology-rainfall-output complex. It is felt that these refined coefficients will give a better understanding of proper enterprise relationships among available production alternatives. It was anticipated that, primarily because of weather variations, three to five years would be needed to complete the study.

In an equilibrium analysis of the geographical distribution of burley tobacco production under alternative Government control programs, which was initiated during the latter part of the last year, little has been done other than planning. Some preliminary estimates were obtained on the labor supply available and wage rates in various areas of the Burley belt. Regression analysis has been used in an attempt to relate the supply of labor to farm wage rates, nonfarm wages, and the unemployment rate.

E. Appraisal of Adjustment in Wheat Areas

The studies on adjustments in wheat areas in the Plains and in the Pacific Northwest are now reoriented to the needs of Cooperative Regional Research Projects W-54 (revised) and GP-5 (new). The technical committees of these projects have developed equilibrium price-supply response models for the



Table 1.--Optimum aggregate cotton acreage for assumed cotton allotment and price situations for selected study areas in the southeast

| Area                               | Level of cotton allotment percent of 1965 and cotton price (cents per pound) |       |       |       |       |       |       |       |       |       |       |       |
|------------------------------------|--|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                                    | 55   |       |       | 85    |       |       | 100   |       |       | 115   |       |       |
|                                    | 31.2   | 36.4  | 26.0  | 31.2  | 36.4  | 20.8  | 26.0  | 31.2  | 36.4  | 20.8  | 26.0  | 31.2  |
|                                    | 1,000  | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
|                                    | acres  | acres | acres | acres | acres | acres | acres | acres | acres | acres | acres | acres |
| Sand Mountain, Ala.-----           | 96.6   | 96.6  | 148.8 | 148.8 | 148.8 | 99.8  | 175.6 | 175.6 | 175.6 | 109.5 | 201.6 | 201.6 |
| Limestone Valley, Ala.---          | 151.7  | 151.7 | 233.9 | 233.9 | 233.9 | 236.2 | 275.6 | 275.6 | 275.5 | 267.1 | 316.6 | 316.6 |
| Limestone Valley, Ga. & Tenn.----- | 68.2   | 68.2  | 105.1 | 105.1 | 105.1 | 90.3  | 129.9 | 129.9 | 129.9 | 101.0 | 142.3 | 142.3 |
| Wiregrass, Ala.-----               | 100.8  | 100.8 | 156.0 | 156.0 | 156.0 | 132.9 | 132.9 | 132.9 | 132.9 | 152.6 | 210.3 | 210.3 |
| Southwest Coastal, Ga.---          | 106.2  | 106.2 | 164.2 | 164.2 | 164.2 | 131.5 | 193.1 | 193.1 | 193.1 | 151.1 | 222.1 | 222.1 |
| Piedmont, Ga. & Ala. 1/---         | Inc.   | Inc.  | Inc.  | Inc.  | Inc.  | Inc.  | Inc.  | Inc.  | Inc.  | Inc.  | Inc.  | Inc.  |
| Piedmont, S. C.-----               | 65.7   | 65.7  | 0     | 76.8  | 76.8  | 0     | 0     | 81.9  | 81.9  | 0     | 0     | 87.0  |
| Economic Area 5 & D, N.C.:         | 32.7   | 32.7  | 0     | 38.3  | 38.3  | 0     | 0     | 40.8  | 40.8  | 0     | 0     | 43.3  |
| Economic Area 6 & E, N.C.:         | 49.8   | 49.8  | 77.0  | 77.0  | 77.0  | 19.6  | 89.7  | 89.7  | 89.7  | 19.6  | 102.4 | 102.4 |
| Brown Loam, Tenn. 1/----           | Inc.   | Inc.  | Inc.  | Inc.  | Inc.  | Inc.  | Inc.  | Inc.  | Inc.  | Inc.  | Inc.  | Inc.  |
| Sand Hills, S. C.-----             | 43.6   | 43.6  | 37.9  | 67.3  | 67.3  | 0     | 44.6  | 79.2  | 79.2  | 0     | 51.3  | 91.1  |
| S. C. Census Area 28-----          | 157.1  | 157.1 | 242.9 | 242.9 | 242.9 | 151.9 | 285.7 | 285.7 | 285.7 | 174.7 | 328.7 | 328.7 |
| Ga. Census Area 28 1/----          | Inc.   | Inc.  | Inc.  | Inc.  | Inc.  | Inc.  | Inc.  | Inc.  | Inc.  | Inc.  | Inc.  | Inc.  |
| S. C. Census Area 16-----          | 53.6   | 53.6  | 0     | 83.5  | 83.5  | 0     | 0     | 98.1  | 98.1  | 0     | 0     | 112.7 |
| N. C. Census Area 16-----          | 49.7   | 49.7  | 0     | 77.6  | 77.6  | 0     | 0     | 91.0  | 91.0  | 0     | 0     | 104.6 |

1/ Estimates for these areas have not been completed but are expected to be available Jan. 1, 1966.

respective regions on the pattern of NC-54 in feed-livestock, and the Great Lakes and Northeast dairy studies. Reorientation of wheat adjustment studies has required a new delineation of adjustment study areas and a redefinition of representative farms. Much of the previously developed input-output data and farm resource situations data can be reused, but data on livestock enterprises are being developed. Three more reports are planned.

In the three Southern Plains States, the main effort is in specifying resource restrictions for representative farm situations, and the development of budgets using crop yields and livestock production rates adjusted to 1970. In program testing, Colorado is investigating the effect of variable pricing of labor, Kansas is testing the effect of size, and Nebraska the effect of cattle feeding on farm earnings.

In Nebraska three major adjustment areas have been delineated. For each area data on farm organization, crop acreage, and livestock numbers for a sample of farms have been tabulated from the State agricultural census. From these data, nine typical farm resource situations based on three size groups and three types of farms will be used to represent farming in each area.

In Colorado the work has concentrated in the Southeastern area. Resource situations were established for three typical farm organizations. Preliminary analysis indicates that at 90 cents a bushel for wheat some of the less productive land would be shifted from wheat to seeded pasture for a cow-calf-yearling enterprise. One research report based on the study was published.

In Kansas the major activity has been in the Northeastern cash-grain area. Three farm resource situations--cash-grain, grain-livestock, and irrigated--have been identified and defined. Crop and livestock budgets have been developed. In central and southwestern Kansas the farm resource situations have been tentatively identified. A professional journal article based on the study was published.

In Montana the work has been concentrated on the development of input-output data for major product enterprises in each of three study areas with crop yields projected to 1970. Also a beginning has been made on resource restrictions for representative farm situations. As an aid to eventual aggregative analysis, projections have been made of the number of farms to 1970, 1975 and the year 2000 for the State, for each adjustment area and for individual counties. Farm numbers may decrease 16 percent by 1975 and 31 percent by 2000 as compared with the number in 1959 (census year).

In North Dakota all of the enterprise input-output coefficient have been formulated and preliminary programming has begun in the Southwest area to test the GP-5 study assumptions as to farm size and interest rates. In the Northwest area, input-output enterprise coefficients are being



developed in cooperation with the Agricultural Experiment Station in connection with a study of farm size. A manuscript reporting the analysis of grass seeding on cropland in the Southeastern area has been prepared. Results indicate that grass seeding of some cropland would be profitable, especially hay production. With wheat priced at \$1.30 or more, wheat production would be more profitable than grass seeding on most of the cropland.

In South Dakota six adjustment areas were delineated on the basis of adapted crop enterprises which largely reflect climatic variations (spring versus winter wheat) and soil differences. Enterprise budgets and resource restrictions have been developed for representative farms in the North-central spring wheat area. A manuscript describing in detail the farm resource situations in eastern South Dakota is being prepared for publication.

In Washington programming of optimum adjustments has been completed for one of the major farming areas of eastern Washington and northern Idaho. A bulletin manuscript describing the methods and results is now in progress. Farm numbers, size distributions, and total cropland acreages have been determined for 11 additional areas. Construction of cropping budgets is progressing for each area. Programming to estimate output responses to changing product prices will be started soon. Some work has been done on possible methods of constructing aggregate models to observe more directly the output response and adjustment processes of regions and subregions. The results of this endeavor were presented to members of the Pacific Northwest Study Group in January 1965, and to members of the Farm Production Economics Division in April 1965.

In Oregon a manuscript on cattle enterprises on wheat farms in the Columbia Basin of Oregon was prepared. Some preliminary programming was done to test a model to be used in the W-54 project. A mail questionnaire to determine current trends in cattle enterprises on wheat farms revealed that of a total of 1,924 wheat farms, 32 percent had never had cattle, 58 percent have cattle at the present time, 23 percent started, and 10 percent sold their beef herd in the past 10 years, and 1 percent entered and left the cattle business in the past 10 years. This trend to more cattle on wheat farms was expected in view of a favorable ratio of cattle prices to wheat prices in the Columbia Basin in the last 15 years.

#### F. Appraisal of Adjustments in Rice Areas

In studies of adjustments in rice areas, emphasis has been given to (1) the development of aggregates of production, selected inputs and returns with varying rice prices and assuming no production controls, and (2) the effects of alternative allotment levels on production and returns. Aggregations with no allotments were completed for major rice-producing areas of Texas, Arkansas, Mississippi, and Louisiana. With advanced technology and all crops at base prices, the aggregate rice acreage would total 2.2

million acres and production would amount to 109 million hundredweight of rice. In 1964, these areas harvested about 1.0 million acres of rice and produced about 41 million hundredweight. Prices received had a marked effect on rice production under the assumptions used in this study. With rice priced at \$4.00 per hundredweight, 2.5 million acres of the crop would be grown. If rice prices are reduced to \$3.00, acreage would drop to 1.3 million acres. Only 200,000 acres would be planted at a price of \$2.30 per hundredweight. A similar analysis is underway for the principal areas of rice production in the Sacramento Valley of California. The programming of optimum organizations for representative farms assuming alternative allotment levels for rice is completed for Arkansas and is getting underway in all areas.

#### G. Appraisal of Adjustments in Feed-Livestock Areas

The cooperative regional study (NC-54) of adjustments in hog and beef cattle production in the Corn Belt is progressing to the aggregation phase. The solutions of linear programming models of optimum adjustments for representative farms in the principal hog and beef cattle producing areas in the Corn Belt under alternative prices are being aggregated by areas and for the region at Purdue University. The principal assumptions established by the NC-54 Committee were: The acreage of the representative farms was fixed; corn acreage was limited to historical levels; price of corn bought was 10 cents above sale price; real estate credit of up to 50 percent of the value of the farm was available as a source of credit for operating capital; and technical coefficients were based on improved management. In several States the programming of the representative farms is being expanded to include alternative restrictions such as allowing limited change in size of farm, agronomic restraints on corn acreage, average management, no real estate credit and a reservation price for family labor. Preliminary results indicate that, under the NC-54 assumptions, Corn Belt farmers have the potential to produce much larger quantities of pork and beef than they produced in 1964. The more restrictive assumptions caused the supply curves to shift to the left, especially at the higher price levels. The aggregation models will include explorations with a more aggregate model to consider directly the input supply and demand elasticities.

Analysis of economic adjustments to changing prices in West Central Ohio has been completed for 320-acre farms. A report will discuss adjustments made by a sample of farmers during a 5-year period and optimum organizations for the same farms. The results indicate that changes in the size of farms is the most adjustment that farmers made. Some new and significant improvements have been developed in the analytical models used in this study.

Production problems and adjustments on range-livestock ranches are being studied in California, Oregon, Texas, and Montana. In California, a field survey of 193 livestock ranches, primarily without Federal rangeland



permits, was completed. A preliminary analysis indicates that the tremendous increase in land values witnessed in California together with increased land taxes is forcing many ranchers to make adjustments in their organization and operations. Forty-five budgets representing 26 cattle and 19 sheep operations in various ranching areas in California are being developed from data obtained from the 193 livestock ranchers interviewed. In addition, 25 cattle and two sheep budgets from the 1961 grazing study have been updated to complete the cross section representation of California livestock ranches. The major portion of the budgeting procedure has been formulated. The data from these budgets will be refined and organized for the purpose of developing a general supply response model for the California range-livestock industry, and a firm simulation model for the northeastern intermountain area of California.

In Oregon, the research has centered on development of a framework for analysis, defining the population of ranches, and assembling the necessary data. Cattle ranchers in three southeastern Oregon counties were randomly selected for survey in a way that will allow aggregative checks with census reporting districts and permit analytical procedures related to Bayesian estimators in multivariate analysis. Although the progress has been slow, the results when applied may prove highly worthwhile. For instance, the possibility of integrating secondary information and primary sample data offers considerable promise. This would allow the use of accumulated nonstatistical information directly in the model in a way that should improve the efficiency in estimating structural parameters. Progress during the past year toward demonstrating these techniques for direct research application appears promising.

In Texas, work continued on 30 representative ranch budgets for the High and Rolling Plains Land Resource Areas of Texas. Seventeen ranch resource situations were identified in the Edwards Plateau and Central Basin Land Resource Areas from interviews with 108 ranchmen with respect to investment, management practices, input-output relationships, costs, and income. A manuscript, "An Economic Model for Evaluating Ranch Management Decisions Over Time," is being reviewed for publication. The thesis from which the manuscript was taken has been circulated to range economists and range specialists with the Soil Conservation Service, U. S. Forest Service, and Bureau of Land Management. The results of this analysis indicate that dynamic linear programming, in the sense that time is a variable, has a definite place in ranch economic studies. In the East Rolling Plains of Texas, aerial spraying of mesquite-infested rangelands with 2,4,5-T represents an important source of additional ranch income. This is particularly the case for ranches that include only rangeland and have no cropland for providing supplemental grazing to livestock. The most profitable utilization practice among those considered includes a year-long cow-calf system on ranches without cropland, and a combination year-long cow-calf and seasonal stocker system on ranches with cropland. The percentage increase in net income from spraying mesquite varied from 7.4 to 8.1 percent on ranches without cropland, and 3.9 percent to 4.4 percent on ranches with cropland.

In Montana, census data for 1959 are available on half the beef cattle ranches with 20-49 beef cows and on all ranches with 50-500 beef cows. The number of ranches that fall into the different sized cow herd categories is as follows:

| <u>Number of cows<br/>in breeding herd</u> | <u>Number of<br/>ranches</u> | <u>Percent of<br/>total ranches</u> |
|--|------------------------------|-------------------------------------|
| 20 - 49                                    | 2,960                        | 35.3                                |
| 50 - 74                                    | 1,580                        | 18.7                                |
| 75 - 99                                    | 1,130                        | 13.5                                |
| 100 - 149                                  | 1,205                        | 14.4                                |
| 150 - 199                                  | 597                          | 7.1                                 |
| 200 - 299                                  | 510                          | 6.1                                 |
| 300 - 500                                  | 229                          | 2.7                                 |
| Over 500                                   | <u>165</u>                   | <u>2.0</u>                          |
| Total                                      | 8,376                        | 100.0                               |

For the ranches with 20-500 cows the total number of cows in the various size categories is as follows:

| <u>Number of cows<br/>in breeding herd</u> | <u>Total number of cows<br/>in each size category</u> | <u>Percent of<br/>total</u> |
|--|---|-----------------------------|
| 20 - 49                                    | 102,764   | 13.7                        |
| 50 - 74                                    | 95,890  | 12.8                        |
| 75 - 99                                    | 98,078  | 13.1                        |
| 100 - 149                                  | 145,212   | 19.3                        |
| 150 - 199                                  | 103,063   | 13.7                        |
| 200 - 299                                  | 118,925   | 15.8                        |
| 300 - 500                                  | <u>87,191</u>   | <u>11.6</u>                 |
| Total                                      | 751,123   | 100.0                       |

Resource combinations for each size category were analyzed. The resources considered were: Total land, irrigated cropland, woodland pasture, rangeland, hayland, irrigated pasture, and cropland used for pasture. The haylands were broken down into three categories: (1) All hay, (2) alfalfa hay, and (3) wild hay. Some other factors considered were days worked off the farm and the importance of public grazing permits to the ranchers. About 65 percent of the beef ranches had a wheat enterprise. The range was from 75 percent in the 20-49 cow-size category down to 40 percent in the 300-500 cow-size category. If all grain crops are included, 75 percent of the ranches had a grain enterprise. In two subareas, over 90 percent of the beef ranches had a grain enterprise. In every subarea at least half the ranches grew grain. Total land ranged from a low of 5 acres to a high of 99,000 acres. However, most of the ranches had between 1,000 and 4,000 acres of land. Only about 5 percent of the ranches had no rangeland.



The initial findings of this study will be useful in drawing meaningful samples of ranches and setting up a linear programming model to be used in more detailed studies of the industry. The model will be used for representative ranches when the data are collected for such ranches. Development of the model before collecting the data will facilitate more exactness in specifying the data needed.

A draft of a manuscript, "Cattle Feeding Costs in Nebraska by Systems of Feeding and Size of Operation," has been prepared and is presently undergoing revision for publication. Economies of size exist with respect to labor, improvements, and equipment. But feed costs, which average about 75 percent of total costs and are not subject to economies of size, are sufficiently lower in many farmer-feeder operations to offset most or all of the advantage that the larger more specialized feeder may have in labor, improvement, and equipment costs. This is especially true of the calf system. The farmer-feeder's financial position is less vulnerable to unexpected price declines because he is more diversified; he feeds light-weight cattle; he or his family furnish all or much of his labor; and he uses some of his equipment and improvements for several enterprises. Although economies of size do not appear to be a serious threat to the competitive position of the farmer-feeder, especially those who feed calves, his future is not necessarily secure. The effects of current trends in the purchasing and marketing of cattle were unassessed in this study. Additional study is needed with respect to the bargaining position of the farmer-feeder and in his ability to fit into the type of market structure now evolving. Decentralization of packing centers, increased direct selling, and decreased selling through the terminal market may necessitate a drastic change in the farmer-feeder's marketing methods for survival.

In Colorado, input-output data were developed for selected livestock systems and for alternative crop enterprises on three classes of irrigated cropland. Trial runs have been made to check the linear programming model to be used in later stages of the project. Material developed in the course of the project has been used in a series of meetings conducted by the Colorado Agricultural Extension Service.

In Arizona, progress on the study of economics of beef production was delayed by practically full-time assignment during the year of personnel to other research.

#### H. Appraisal of Agricultural Policies and Programs

In a study of the 1962 Feed Grain Program, the factors associated with farmer participation were analyzed. In the Texas High Plains 12 factors thought to be associated with participation were tested by linear discriminant analysis. Together they correctly "predicted" the participation status of 82 percent of the 344 farmers in the study sample. Further analysis will show the relative importance of the 12 factors. Factors in the Corn Belt are being similarly analyzed.

An appraisal of the 1962 Feed Grain Program as it applied to barley producers in the Pacific Northwest was made to identify factors associated with participation in the program, learn the effects of the program on production adjustment, and determine the likely response of farmers to alternative program provisions. Two hundred and five farmers were interviewed including 157 participants in the program and 48 nonparticipants who were eligible to participate. In the Pacific Northwest about 21 percent of the farmers participated in the barley program. For the United States as a whole, 21 percent of the eligible farmers participated in the barley program compared with 41 percent in the corn-grain sorghum program.

Farms in the barley program were larger in total acres but had about the same cropland acreage as nonparticipants. Feed grain bases averaged 163 acres on participating farms compared with 122 acres on nonparticipating farms. Normal yields assigned to the farms by the County ASCS Committees for the purpose of computing diversion payments averaged almost the same for the two groups of farms; actual yields in 1962 were 10 to 20 percent above normal. The acreage diverted on the participating farms averaged a little more than 5 percent of the cropland.

In 1962, since the market price of barley in the Pacific Northwest was as high or higher than the support price, the support price offered little advantage to farmers as individuals. Cash costs of producing barley were low relative to the value of production. As diversion payments were low relative to the net return above cash costs, they also offered little incentive to farmers to participate.

Except for slightly higher participation among operators under 35 years of age, there was little correlation between age of operator and participation in the barley program. About half the farmers reported they would prefer a 5-year program to annual programs; the proportion was slightly higher among nonparticipants.

A study of the 1962 Feed Grain Program in Ohio was completed and a manuscript prepared for publication. This study isolates the pertinent relationships between income from the production of corn and changes in actual corn yields and changes in the relation of actual yields to normal yields assigned by the County ASCS Committee for purposes of computing diversion payments.

The farms of participants in the 1962 Feed Grain Program in North Carolina were larger, had larger feed grain bases, had higher yields, and a greater proportion were cash-crop farms than nonparticipants' farms. These differences were revealed by a study of 1942 representative farms in the Central Coastal Plain of North Carolina. Important differences in land-use resulted from participation in the 1962 Feed Grain Program. Participants used only 14 percent of their land for corn in 1962 compared with 46 percent for nonparticipants. They used 50 and 82 percent, respectively, of their land for soil-depleting crops, and allowed 21 and 12 percent,



respectively, of their land to remain idle though not diverted under any program. No significant differences in the amount of fertilizer applied per acre could be found between participants and nonparticipants; neither was there any significant change between 1961 and 1962 in the amount of fertilizer applied per acre of corn.

Participants were largely from the middle age groups and more of them worked off the farm. Eighty-seven percent of the participants were 36 to 65 years of age compared with 66 percent of nonparticipants. Forty-one percent of the participants worked off the farm for wages compared with 26 percent of the nonparticipants.

Cost and yield data from 122 of the sample farms were used to budget net returns from the corn enterprise. With 1962 realized yields averaging 50 percent above the normal yields used in computing diversion payments, only 14 percent of the 1962 participants maximized net farm income from participation. A similar proportion of 1962 nonparticipants would have gained from participation.

A study of the 1964-65 Cropland Conversion Program was initiated in six areas to identify the characteristics of farms participating in the program, the adjustments made in production, and the efficiency of the program in reducing output of surplus commodities. The efficiency associated with different levels of adjustment payments relative to the productivity of the land is also being studied. Field surveys have been completed in Georgia, Louisiana, Arkansas, Indiana, Illinois, and Colorado, and will be completed in North Dakota in October.

#### I. Cotton Cost Analysis

As part of the Department's expanded research on the economics of cotton production, the Farm Production Economics Division has initiated a new program of research designed to measure year-to-year changes in costs of producing cotton and to appraise the means of reducing production costs. This research includes: (a) Annual measurement of costs, and of the effect of changes in inputs, prices and yields on the cost of producing cotton; (b) economic appraisal of changing technology in cotton production, with emphasis on the means of reducing production costs; and (c) studies of land values and prices in cotton-producing areas, including the development and evaluation of alternative methods of measuring land input and land cost in cotton production. A nationwide survey of 5,200 cotton farms was made in February and March 1965 to obtain information on cotton production practices and costs. Findings are not yet summarized.

Cooperative research on cost reduction has been initiated with several State agricultural experiment stations. It will study the economic feasibility of new technologies now being developed in the experiment stations. Further, it will study the innovations on actual farms. For this purpose a list sample is being prepared of farmers who are innovators in at least one of

the following categories: (1) Land preparation, (2) fertilization and seeding, (3) weed control, (4) insect control, and/or (5) mechanical harvesting and marketing. These innovations and their cost reducing effects will be analyzed in detail.

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## AREA NO. 2. ECONOMICS OF FARM MANAGEMENT AND CONSERVATION PRACTICES

Problem. There are marked differences among the major agricultural areas in the physical and economic environment which determine the possibilities and limitations on successful operation of farms. Information is needed for each type of farming region on the patterns of production resources and systems of farming used by individual farmers; the production requirements and output obtained from various enterprises with different methods of operation, including especially those practices that aid in soil and water conservation; the relationships between size of operations, combination of enterprises, production practices used, efficiency in production, and farm financial returns; and alternative opportunities for desirable adjustments, particularly those which conserve soil and water, on farms of different sizes, types and physical conditions.

### USDA AND COOPERATIVE PROGRAM

A continuing long-term program of research dealing with the economics of farm management practices is conducted in cooperation with 12 State experiment stations. In the northeast region, emphasis is on input-output relationships for dairy forage and poultry. In the Corn Belt, research emphasizes hog production. In the southern region, emphasis is on mechanization and various patterns of skip-row planting of cotton, and in the western region attention is given to mechanization. Studies of the economics of conservation practices are emphasized in Wisconsin, Missouri, and Texas. While major attention is given to determining input-output relationships, emphasis is also given to economic analysis within the framework of profitability to the farm firm.

A total of 4.0 Federal professional man-years was devoted to this area of research--2.0 man-years in economics of farm management practices and 2.0 in economics of conservation practices.

### PROGRAM OF STATE EXPERIMENT STATIONS

Farm management research conducted in this area at State agricultural experiment stations can be divided into two major categories. In the first, the research is designed to determine the efficiency of specific crop and livestock operations, the optimum combination of enterprises, and the optimum organization of total farm resources. Also, some studies are specifically addressed to the problems of soil conservation and their effects on resource productivity and farm costs and income. The second segment of work encompasses the basic research dealing with managerial ability and decision-making processes of farm managers. This research is confined to the north central region and is conducted under the regional study NC-59 "The Identification and Measurement of Managerial Ability and Its Effect on Resource Use in Farming." The six States cooperating in this study are investigating the

relationships between attributes of farmers and their managerial ability; determining the productivity of agricultural resources under different operational and organizational arrangements; and establishing a management index by identifying, weighing, and measuring the components of a management factor in agriculture. The station effort devoted to the area of research amounts to 31.3 professional man-years.

## PROGRESS -- USDA AND COOPERATIVE PROGRAM

### A. Economics of Farm Management Practices

An analysis of the effects on farm income of alternative resource organizations in the production of market eggs from representative poultry farms in Connecticut was concluded. The study showed that net returns were significantly changed by choice of nesting system used in a floor management housing program, method and equipment combinations for processing eggs, replacement policy, and size of operation. Evaluation of nest alternatives indicated a higher net return with either a center-aisle or community-type nest system than with a conventional system. Less profitable models used mechanical or roll-away type nest alternatives. On models of similar size, higher net returns were derived when eggs were farm sized rather than packed as clean unsized eggs. However, large-sized units are necessary to derive income benefits of using egg-processing equipment, which may utilize labor more effectively, but require greater investments. Similarly, higher net incomes were indicated on model farms if replacements were purchased as starter pullets rather than raised, as labor can be used to care for more layers. However, lower unit costs were usually shown if replacements were raised. Unit cost advantages for either a center-aisle or a community-type nesting system were slight as compared to conventional systems, providing annual output was constant. Most of the cost reduction opportunities were obtained with an output of 400,000 dozen, and from this output to a million dozen, costs were nearly constant.

The 1963 records of 154 farmers in southeastern Minnesota and 143 farmers in southwestern Minnesota were summarized and reports of major findings were published. During the last several years returns from livestock have been relatively small compared to crops. From 1959-63 the net returns per hour in crop production were about \$3.00 and \$3.35 for southeastern and southwestern Minnesota, respectively. Hourly returns for livestock production were \$0.50 in southeastern Minnesota and zero in southwestern Minnesota. The low or negative returns to beef cattle feeding during this period were major factors contributing to the relative low returns for livestock.

A survey of the use and potential development of the agricultural resources in the Belle Fourche Irrigation Project and adjoining areas has provided considerable useful information for determining the feasibility of an increase in livestock feeding using locally-produced feed. The sample farms data indicate that little expansion is possible with present feed supply. Almost 80 percent of the corn and 90 percent of other feeds were fed on the farms where produced.



In a study of alternative systems of hog production in Illinois, two reports were published during the year. In addition, investments, resource requirements, costs and returns were reported for 21 selected pasture and confinement systems of hog production. The enterprise budgets cover a range in size to the upper limit of cost efficiencies associated with size of enterprise. They will be used primarily in a study of the economics of size of hog farms, but they were published as working data for other researchers.

In a study of the economics of mechanization on Mississippi cotton farms, attention has been given to mechanical cotton gleaners because of the increased number of machines in use by both owners and custom operators. The study has been modified to include ginners of mechanically-gleaned cotton to insure a complete analysis of this practice. A study of the extra large row-crop tractor is well advanced and early indications point to a much higher yearly usage of these machines than had been previously estimated. A probable explanation of this high usage is the trend toward land leveling, chisel plowing, and subsoiling which require considerable drawbar horsepower. The high costs of maintaining track-laying or crawler type tractors in the Delta may have caused a further shift toward wheeled tractors for this type of work. The general acceptance of these larger power units has spurred farm power manufacturers to study the possibility of still larger and more powerful tractors for the future. Information gathered and interest generated by this project has found quick acceptance by farm power and machinery dealers and Delta farmers. Records obtained from farmers indicate that performance rates of tractors with 65 or more horsepower using 6- and 8-row equipment are much higher than any estimates previously made.

In an economic appraisal of alternative systems of farming and ranching in the high-risk areas of Oklahoma, two bulletins were issued on potential short-run and long-run adjustments by Oklahoma Panhandle farmers. The analysis of short-run adjustments indicated that wheat was a more profitable alternative than grain sorghum on clay-loam soils for price ratios greater than 0.62. For sandy soils, no wheat was produced when the price ratio fell below 0.91, and the price ratio had to rise to 1.1 before it was profitable to use all of the wheat allotment. An analysis of fixed capital positions indicated that crop activities yielded higher percentage returns than did livestock. As capital became less limiting, cow-calf livestock activities were added to farms, and feeder steers were the last activities to be added. The study of long-run adjustments indicated that various adjustments, considering effects of owned resources, alternative yield expectations, and the interaction of these items, provide the most plausible explanation of current farm size levels. Farm operators interested in maximizing returns to their owned resources can best withstand large reductions in product prices. Continued reductions in the number of farms and farmers appear likely from this study. A manuscript, "Income Variability of Alternative Plans, Selected Farm and Ranch Situations, Rolling Plains of Northwest Oklahoma," has been approved for publication. Studies to estimate aggregate supply response for resource situations in the Oklahoma Panhandle, Northwest, and North Central Oklahoma were initiated in cooperation with other States working in the

Great Plains regional adjustment project. Crop and livestock budgets have been updated for the Oklahoma Panhandle in order to begin programming designed to estimate production response for this area.

Results of an economic evaluation of forage production and utilization in New Hampshire, reported a year ago, have been included in a manuscript for publication. The time sequence FORTRAN model used in making the analysis will be presented in a separate report.

A study of adjusting to increasing salinity on dry farmed lands of the Lower Rio Grande Valley was carried through a third year. Although this study was initially planned to cover five years, the records summarized thus far indicate that definite operating patterns or bundles of practices are associated with specific crops more than with variations in saline conditions. If the 1965 records support these indications, field work will be terminated and the summarized data will be used in an economic appraisal of the alternative reclamation programs developed by the Soil and Water Conservation Research Branch, ARS, at Weslaco, Texas.

#### B. Economics of Conservation Practices

An economic appraisal was made of the use of water for irrigation on southeastern Missouri farms. The data from the second year (1964) of a controlled field experiment designed to determine the relationships of nitrogen fertilization and soil moisture levels were analyzed. Although severe drought periods occurred during the experimental period, very little response to applied irrigation water was observed. Apparently a highly impermeable soil layer in the soil profile resulted in an extremely low rate of infiltration into the lower root zone. In 1965 the design of the experiment was modified to include two planting dates rather than one, and the number of moisture levels maintained was increased. Analysis of the date-of-planting data on corn is difficult. Considerable time during the year was devoted primarily to development, testing and modification of statistical models designed to measure the relationship of climatological variables and corn yield. Numerous formulations were tried and found to be unsuitable for use in an economic analysis. The most promising model at the present time is one utilizing the techniques of constrained regression developed by R. A. Fisher. In this particular model temperature effects are assumed to be linear within time periods and moisture effects are assumed to be cubic within time periods. The general shape of the yield function for moisture is consistent with that which would be theoretically expected but the scaling of the moisture variable seems to need some adjustment.

An economic evaluation of changes in use of farm lands within Wisconsin watershed projects was terminated. The results of the analysis were reported a year ago. During the current year a concluding manuscript, "Potential Benefits on Farms from Watershed Development," was prepared. This report emphasizes that the Watershed Protection and Flood Control Prevention Act (PL 566) provides unusual facilities for encouraging and implementing efficient

conservation farming, but that the full benefits may not be realized if farming in the watershed is not adjusted to efficient systems of operation. Suggestions are made for more comprehensive watershed work plans and more aggressive implementation.



PUBLICATIONS -- USDA AND COOPERATIVE PROGRAM

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### AREA NO. 3. STRUCTURE OF AGRICULTURE AND ECONOMICS OF FARM SIZE

Problem. The rapid changes in American agriculture are generating many pressing problems. Foremost are questions on the character and magnitude of current trends in the structure of agriculture. What is happening to various sizes and kinds of farms? How are working relationships between farmers and other businessmen changing? Equally significant are questions about causes and effects. What incentives, monetary and other, bring about changes in the structure of agriculture? How do these changes affect farm people, rural communities, and nonfarm agricultural businesses? These are fundamentals on which research is needed so that policy makers, farm leaders, farm people, and citizens generally can gain depth of understanding and essential information for action.

#### USDA AND COOPERATIVE PROGRAM

Novel forms of vertical coordination and reemphasis on old forms have influenced American agriculture in recent years. Basic analysis has been designed to describe existing kinds of vertical coordination and to provide understanding that can lead to improvements. While past attention was centered on coordination of farm production with marketing stages, interest is now directed also to coordination of input resources.

Changes in the number, size, and characteristics of the farm businesses in which American agriculture is organized are continually measured and interpreted. In analyzing these changes, special attention is given to the relative position of various size groups of farms. These relative positions are being developed in terms of total farm marketings, net farm income and farm investment, use of land and hired labor, the age and tenure of operators, and the organization of farm production by commodities and by farm and nonfarm sectors.

The potential efficiency and profitability of different sizes of farm are being determined for major types of farming in selected areas. Further refinement of this analysis includes a determination of the feasible and likely future changes in farm-size patterns as farms gravitate toward more efficient or more profitable sizes. This includes a consideration of the present position of actual farms in the selected areas, and the impediments these farms will encounter as they strive for more efficient or more profitable sizes and organizations. Initially this analysis will take place at the individual farm level. The growth of the firm is analyzed in a multiple period context, taking into account the farm's present size and equity position, and the availability of additional resources, including labor, credit, and land. This leads to a consideration of the simultaneous developments of all the farms in the selected area. Thus, the analysis is eventually conducted at the farming-area level of aggregation.

A total of approximately 9.4 Federal professional man-years is being devoted to this research area: Vertical coordination, 1.1 man-years; economies of farm size and numbers of farms, 8.3 man-years.

#### PROGRAM OF STATE EXPERIMENT STATIONS

Most of the studies under way at the State experiment stations dealing with the structural aspects of agriculture and the economics of farm size are reported under adjustment research (Area No. 1). One study on structural adjustments in the agribusiness sector of a State's economy is under way in the North Central region. Under this study the changes occurring in the numbers, sizes, types, and locations of agribusiness firms and the effects on level of employment, income generated, and value added are being determined. Two studies concerned with vertical coordination in agriculture are also under way in the same region. One study will determine the effect of vertical integration on agricultural marketing efficiency while the other will evaluate contracts used by tenants on pork producing farms and determine their effects on resource use efficiency and income. The stations are devoting 6.1 professional man-years to this area of research.

#### PROGRESS - USDA AND COOPERATIVE PROGRAM

##### A. Vertical Coordination

The working model of a computer simulation for a dairy farm was tested, the preliminary draft manuscript rewritten, and the final manuscript prepared and approved for publication. The results constitute a prototype simulation technique for making management decisions on a typical dairy farm. Steps in the construction of the model are presented in Fortran, flow chart, and ordinary language. In this way the method is readily available for others to use. This report, now in press as a USDA Agricultural Economic Report, is entitled "A Simulation Technique for Making Management Decisions in Dairy Farming".

A study of changing structure and performance of the American agricultural chemical industry and its coordination with farms was initiated. This will be a descriptive and analytical study tracing the evolution of agricultural chemical businesses and their relationships to farming.

##### B. Economics of Farm Size and Numbers of Farms

Analysis of changes in the number and size of all farms and of changes in the number and size of family and larger-than-family farms has clearly demonstrated the error of identifying the postwar changes in number, production, and size of farms with the concentration of farm production into large non-family operations. Adequate family farms were, and still are, the mainstay of American agriculture. All farms using less than 1.5



man-years of hired labor were classified in this study as family farms. Family farms with \$10,000 or more of sales were classified as adequate family farms. In 1949 there were 17 family farms for each larger-than-family farm. In 1964, that ratio increased to 26. For every \$100 of sales by larger-than-family units, family farms marketed \$195 in 1949 compared to \$275 in 1964. In 1949, family farms represented 42 percent of marketings in the expanding sector of farms (those with \$10,000 or more of sales), whereas in 1964 the comparable percentage was 67. Farm production was increasing 14 times as fast for family farms with \$10,000 or more of sales than for larger-than-family farms in the same sales group.

In order to understand the rapidly changing structure of both the farm and nonfarm sectors of our agriculture, an improvement of the present classification of farms by size and type of operation is called for. A paper, "The Contribution of the Economic Classification of Farms to the Understanding of American Agriculture" by Radoje Nikolitch and Dean E. McKee (presented at annual meeting, Amer. Farm Econ. Assn., Oklahoma State University, August 24, 1965), shows that interfarm trade in feed, livestock, and seed present the main problem so far as purchased inputs are concerned in classifying farms by gross sales. Consequently, an adjustment of gross sales for interfarm trade in those items would considerably improve the comparability of gross sales by type of farm and region. The specialization of livestock farms makes necessary groupings of farms by new types. This is especially the case for "drylot" cattle feeding establishments, "drylot" milking organizations, and broiler farms.

The relationship between farm size and average total cost has been determined for 2 different types of farming in 3 selected areas. Work is continuing on 6 types of farming in 5 States. Published findings of the cotton study in the Texas High Plains show that a 440-acre irrigated cotton farm operated by one man with a large tractor and a full complement of 6-row equipment can be more efficient than any larger farm size presently considered feasible in the area. This highly efficient one-man farm earns nearly a \$20,000 annual return to operator labor and management. Larger farms ranging up to 1,800 acres employing as many as 4 full-time hired men, with a full set of large equipment for each man, can be almost as efficient as the one-man farm. But the higher volume of these larger farms provides an opportunity for considerably higher returns to a farmer who can gain control of the necessary capital (over \$1 million), and has the management ability to coordinate the efforts of several hired men.

A forthcoming report of the Colorado beef feedlot study shows that important economies of size may be exploited up to feedlot sizes that can handle 1,500 head of yearlings at one time. Average cost continues a gradual decline up to about 3,000 head capacity, but declines very little as size increases from 3,000 to 15,000 head capacity. Thus most of the economies of size are attained by a feedlot enterprise of 3,000 head capacity. Three full-time men can handle an operation of this size. Plant and equipment for such a firm would cost more than \$106,000, exclusive of livestock.

A forthcoming research bulletin reports the findings of the irrigated cotton farm study in Fresno County, California. Average cost curves were calculated for two separate areas, one containing light soil, the other heavy soil. In both areas, the four-man farm achieves all or most of the potential economies of size. In the light soil area, the four-man farm consists of some 700 acres, and produces \$150,000 worth of farm products. The heavy soil counterpart of this farm contains some 1,300 acres, producing gross sales of \$275,000.

Minnesota dairy farms up to a 91 cow herd size were analyzed, and the results were published. One-and two-man farms were considered. Average total cost declines sharply as herd size approaches 48 head, but little gain in efficiency is attained by further expansion. Modern milking parlor arrangements were found to be considerably more efficient than the conventional stanchion systems. The 48 cow dairy is a one-man operation with more than \$164,000 of investment capital, including some 290 acres of land and a double 6 herringbone milking parlor arrangement. The two-man dairy farm can handle up to 91 cows, using nearly twice the acreage and investment of the one-man farm, and it achieves slightly lower average costs. Analysis of larger dairy farms with advanced technology is being completed, using plant specifications developed by agricultural engineers and dairy specialists. The overall results will be reported in a research bulletin.

Analysis of economies of size for wheat-pea farms in Washington is near completion and a manuscript is being prepared. Risk and uncertainty considerations are being incorporated as a refinement of the size-efficiency analysis. Preliminary results show the one-man 1,800 acre wheat-pea farm to be slightly more efficient than larger farms, up to a two-man 3,600 acre unit. When completed, the results will show the growth potential of different sizes of farm, based on alternative management strategies.

In the vegetable farm study, a sample survey of growers has been completed and the data have been compiled and summarized. As the study progresses, it should provide insight into the nature and extent of the economies of size available to vegetable growers in the Salinas Valley, California.

Computations for the analysis of corn farms and hog farms in Illinois are now being carried out. As the results become available, they will indicate how large farms of these types must be to achieve efficient and profitable operation.

The collection of data for the study of tobacco farms in North Carolina has been completed. Data from a 300-farm sample survey have been compiled and are being tabulated and summarized. This study involves a consideration of the costs associated with the operation of a tobacco farm composed of two or more spatially separated plots. Growth potential of tobacco farms is also being analyzed, taking into account such factors as family labor supply, capital equity, and availability of additional tobacco allotment on nearby tracts.

At the national level, a comprehensive report is being prepared on the economies of farm size. This report compiles, summarizes, and interprets the results of some 40 empirical studies from various parts of the country, including the studies by this Division that have reached the reporting stage. These 40 empirical studies include a number of different analytical procedures, ranging from simple examination of actual farm records to highly refined synthetic firm analysis using budgeting and linear programming. One contribution of this comprehensive report will be to provide a deeper understanding of these diverse procedures, indicating what can and can not be inferred from the size-efficiency relationships derived by the various analytical procedures. This knowledge should be useful in interpreting other economies-of-size studies that will be forthcoming in the future from the various State experiment stations and other sources. Hopefully, the report will also provide researchers and research administrators with a better basis for selecting (a) the areas and types of farming in which additional economies-of-size studies could profitably be mounted, and (b) the appropriate analytical procedures to be used, as dictated by the kinds of inferences desired and the type of farming involved. This report will be published as a USDA technical bulletin.



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#### AREA NO. 4. FARM CAPITAL, CREDIT, AND FINANCIAL CONDITION

Problem. Farm capital and credit requirements, and the financial condition of farmers, are changing continuously. In the last several years total farm debt has risen sharply. These changes result from the explosive effects of new technologies in agriculture, from the increasing integration of agriculture and other industries including contracts for production, and from changes in farm prices, costs, income, land values, and types and sizes of farms. Continuous study is needed to keep abreast of the changing capital requirements for various tenures, types and classes of farms, and to determine how farmers accumulate the capital needed for their operations and whether credit institutions are providing adequately for farmers' changing credit needs. The developing debt situation requires continuous appraisal. Better tools need to be developed for measuring the effects of the changes in agriculture and in farm capital and credit usage on farmers' assets, debts, and equities. Studies are needed for the guidance of farmers and credit institutions and to aid policymakers and program administrators in appraising the effects of farm programs.

#### USDA AND COOPERATIVE PROGRAMS

The work in this area comprises a long term program of statistical and economic research in three principal areas: The balance sheet of agriculture and financial outlook; improvement of farm mortgage credit facilities; and short term credit and financial management.

In Washington, D. C., the work on the balance sheet of agriculture and financial outlook involves chiefly the assembly and analysis of statistical and other information on farm assets, debts, and incomes and on factors affecting the financial situation of farmers. The Division has become a clearing house for data on farm debts, to which the major lenders (or their supervisory authorities) report on their own loans to farmers and look for comprehensive information on the entire farm debt situation. In addition the Division assembles data collected elsewhere in the Department and by some other agencies on farm assets and incomes and issues each year two analytical reports: (1) "The Balance Sheet of Agriculture," which measures and explains changes during the last year in the financial situation of agriculture; and (2) the "Agricultural Finance Outlook," which projects current trends and estimates what the farm financial situation will be during the next year. These publications contain the only available comprehensive analyses of the farm financial situation.

As an aid in preparing the Agricultural Finance Outlook, surveys usually are made in the fall to determine the views of farmers, credit institutions, merchants, and dealers concerning the current farm financial situation and prospects for the coming year.

In the work on improvement of farm-mortgage credit facilities in Washington, D. C., data from all available sources are assembled and consolidated to determine the amount and distribution of the farm-mortgage debt, the terms on which farm-mortgage credit is available from the principal lenders, the current volume of loans and repayments, and the extent of farm-mortgage debt refinancing, delinquencies, and foreclosures. Quarterly reports on the mortgage lending activities of the major life insurance and federally-sponsored agencies are obtained and analyzed. At 5-year intervals, cooperative surveys with the Census are made to determine the amount of farm-mortgage debt held by nonreporting lenders. The Census Sample Survey of Agriculture provides periodic data on the distribution of all mortgage debt among the various types, sizes, and economic classes of farms. The data from these activities are used in computing parity prices for agricultural products and in preparing the Balance Sheet of Agriculture, the Agricultural Finance Outlook, the Farm Cost Situation, and the Farm Income Situation. They also are used regularly by the National Agricultural Credit Committee, which meets three times each year to appraise the farm-mortgage situation. Numerous requests for data on the farm-mortgage situation are received each year from legislators, farm organizations, farm journals, the State agricultural experiment stations, and others.

In the research on short-term credit and financial management, statistical work in Washington, D. C. is similar to that done on farm-mortgage credit, that is, serving as an assembly point and clearing house for information on the non-real-estate credit used in agriculture, and analyzing and interpreting the data. The data from this part of the work have uses similar to those for the data on mortgage credit, except that they are not used in computing parity prices of agricultural products. These data are in wide demand. A continuing major project is the analysis of data from the 1960 Census Sample Survey which contained the first comprehensive information on a national scale on both short-term and mortgage debt. Information was also obtained on farm and nonfarm income, on the owned and rented value of farmland, on the tenure and type of farm, and on a number of other important items. During the past year these data were used extensively, along with more current but less comprehensive data, in appraising the growth of farm debt and estimating its relation to the well being and financial stability of farmers and of farm enterprises.

Cooperative work with the agricultural experiment stations of the respective States includes the following: At Madison, Wisconsin, an analysis of financial management on commercial farms in Wisconsin; at East Lansing, Michigan, studies of savings, use of credit, and capital accumulation by Michigan farmers, studies of financing modern large-scale farming operations, and studies of farm managerial processes and performance; at Columbia, Missouri, studies of the financing of homes of rural residents who obtained housing loans from the Farmers Home Administration, and of the financing of homes by rural residents who did not obtain FHA loans; and at Urbana, Illinois, a study to determine the changes in the value of fixed farm assets through time and the effect of these changes on the decisions of farm operators.



Federal professional man-years devoted to this work total 8.7 divided as follows: Balance sheet of agriculture and financial outlook, 0.7 man-years; improvement of farm-mortgage credit facilities, 3.2 man-years; short-term credit and financial management, 4.8 man-years.

#### PROGRAM OF STATE EXPERIMENT STATIONS

Large-scale farming involving heavy cash outlays for operating expenses necessitates effective financial management and use of credit. Studies being conducted are concerned with the farmers' use and knowledge of credit, amount and types of loans needed, extent to which lending agencies are adjusting their operations to meet farm-borrower requirements and factors affecting costs to both borrower and lender. Security requirements, terms of repayment and availability of funds for farming needs are also being investigated. The structure of the capital market and the flow of long-term credit between agriculture and the rest of the economy is an area of inquiry. Estimates are being made of returns to inputs of capital and labor and the productivity of capital in alternative uses for different sizes and types of farms are being determined. A total of 3.1 professional man-years is being devoted to this area of work.

#### PROGRESS -- USDA AND COOPERATIVE PROGRAM

##### A. The Balance Sheet of Agriculture and Financial Outlook

The value of farm assets increased further in 1964 to \$237.6 billion on January 1, 1965, up \$8.7 billion or nearly 4 percent from a year earlier. Farm debts, including price-support loans of the Commodity Credit Corporation (CCC), rose \$2.6 billion, and the equities of farmers and other owners of farm property increased \$6.1 billion.

Realized net farm income of farm operators rose to \$12.9 billion in 1964 from \$12.5 billion a year earlier. Cash receipts from marketings and Government payments combined were up more than \$100 million from 1963; operators' expenses, including taxes, interest, and rent, were down about \$300 million, due mainly to lower feeder cattle prices. Not all of this income, however, was from 1964 production. Because of reduced production of hogs and feed grains and increased exports of farm products, farm marketings exceeded production in 1964 and resulted in a decline of crop and livestock inventories. Valued at average prices for the year, the crops and livestock withdrawn from inventory amounted to \$835 million. Allowing for this change in inventory, the income of farm operators was \$12.1 billion from 1964 production compared with \$13.1 billion a year earlier, when inventories increased by \$614 million.

In 1964, as in other recent years, rising prices of farm real estate resulting from the strong demand for farmland were primarily responsible for the increase in value of farm assets and farm equities. The value of farm real estate rose about \$8.7 billion in 1964. Small increases also occurred in the value of farm machinery and motor vehicles and in the value

of financial assets owned by farmers. But these gains were more than offset by declines in the value of inventories of crops and livestock owned by farmers.

Farm debts, excluding CCC loans, increased about \$3 billion during 1964 and totaled \$36 billion at the end of the year. The farm real estate debt increased by a record amount--\$2.1 billion--but the non-real-estate farm debt increased only \$0.9 billion, less than in either 1962 or 1963. The less rapid increase of non-real-estate farm debt in 1964 probably resulted largely from the decline in feeder cattle prices. Although the number of cattle on feed increased slightly during the year, those on feed January 1, 1965, had been bought at considerably lower prices than the cattle on feed at the beginning of 1964. Consistent with this fact, non-real-estate farm debt increased least during 1964 in the Corn Belt, Great Plains, and Western States. Farm real estate debt increased sharply in all regions.

Data from the 1960 Sample Survey of Agriculture and all other available sources were examined carefully during the year for the light they might shed on the rapid growth that has been occurring in farm debts. Results, as reported in the Balance Sheet of Agriculture and in numerous internal memorandums, indicated that relatively few farmers have had severe debt difficulties so far.

The rapid growth of farm debt since World War II apparently has resulted mainly from the enlargement and improvement of farms and from the increased investments necessary to stock, equip, and operate the enlarged units. The survey data indicate clearly that most of the debt of the more heavily indebted farmers had arisen from borrowing for such purposes. The more heavily indebted farmers owed 70 percent of the total debt of all farm operators at the end of 1960, although they included less than 20 percent of the number of farmers. They operated and owned larger farms than the debt-free and lightly indebted farmers. Because of farm enlargements and increased productivity, the number of farms from which annual product sales are \$10,000 or more has increased steadily, while the number of smaller farms has decreased sharply. Presumably, the increase in farm debt since 1960 also has stemmed chiefly from the use of credit by farmers to enlarge and improve their operations.

Assuming that farmers will continue to use credit constructively, it was concluded that few farmers are likely to encounter serious debt difficulties so long as farm prices and program payments remain near present levels. However, debt difficulties could develop for a considerable number of farmers if returns from farming should sink far below present levels.

#### B. Improvement of Farm-Mortgage Credit Facilities

Farm-mortgage debt rose sharply during 1964, by \$2.1 billion or 12 percent. Debt reached \$18.9 billion at the end of the year. The increase during the year was the largest on record, exceeding the previous high in 1920 by about \$300 million. It compares with an increase of \$1.6 billion or 11

percent during 1963, and an average annual increase of \$1.4 billion from 1960 to 1965. Farm-mortgage funds were plentiful in 1964, and borrowers remained willing to borrow large amounts. Farmers continued to bid strongly for land, raising prices to a record high during the year.

The further large increase of mortgage debt in 1964 raises again the question of whether mortgage loans are being made with reasonable regard to the repayment ability of farmers. This question cannot be answered with finality, but it is reassuring that data for 3 major institutional lenders indicate that loan delinquencies and foreclosures remain low, and that loan repayments continue at a high rate.

A factor that has accelerated the growth of debt, particularly mortgage debt, in recent years is the rapid rate of farm consolidation. When farms are consolidated into larger units, credit often is needed for buying and improving land, for additional investments in machinery and other capital goods, and for larger operating expenses.

The credit needed for farm enlargement has added to the other credit needs of farmers, such as those to finance replacement of wornout or obsolete capital equipment and the transfer of property from one generation to the next. Moreover, when established farmers use their present property as security for loans to enlarge their operations, they can borrow much larger percentages of the value of the property being purchased than can new purchasers who own no land. With their enlarged and typically more efficient operations, the consolidating farmers can usually handle their larger debts.

The continued excellent condition of farm loans, both mortgage and short-term loans, has been a reassuring aspect of the farm debt situation in the years since 1960. The absence of general debt difficulties, even in areas of severe drought or of price declines, is also notable. Even though a sizable portion of total debt in 1960 was owed by farmers with fairly large indebtedness, and although debt has grown substantially since 1960 and probably has become even more concentrated, most farmers have been able to meet their debt commitments when due. This indicates that most indebted farmers have increased their incomes sufficiently to manage their larger debts.

In Missouri two cooperative studies of the financing of rural housing are nearing completion. The data from approximately 400 records and questionnaires have been edited, organized, and summarized. The studies indicate that the Farmers Home Administration rural housing loan program is a significant factor in construction of new homes in rural areas. The direct loans were made mostly to rural nonfarm families who, although not strictly in the poverty class, could not obtain satisfactory home loans from other sources.

Nearly one-half of the respondents who had built or bought rural homes without FHA assistance had been financially able to do so without obtaining any type of mortgage loan at all. Home buyers in small villages and county



seat towns frequently were local farmers or their widows who had sold their farms, retired, and wanted to move closer to town. It appears that these small rural places serve as havens for many elderly people living on low incomes.

In Michigan a report was published showing the capital accumulation process on farms of panel members (a group of 125 farm operators who report monthly on their farm and family financial transactions in addition to their regular farm account business reports). The capital accumulation processes of these farmers are illustrative of the uses which farmers make of credit in building the resource bases of their farms.

The importance of credit to the capital acquisition and capital accumulation process on farms cannot be emphasized too strongly. Of the total sample, 97 percent used credit of some sort at some time in their farm business. Credit from relatives was used by at least 27 percent of panel members, but the institutional sources were used even more. With such importance in the capital acquisition and accumulation process, it is exceedingly important that continuing attention be given to the terms and availability of credit to insure that credit needs of farmers are being met as satisfactorily as is economically feasible.

The figures also re-emphasized the trend toward the need for a larger resource base when starting to farm than in the past. The question then arises as to whether in the future conventional credit arrangements will permit a starting farmer to obtain enough assets to begin, or more importantly to expand to, a farm of sufficient size once started. The findings suggested that rental of real estate is an important alternative for obtaining control of capital without the high investment of ownership.

The results indicated that working on the family farm was also important to the decision to farm as well as to obtaining a capital base to start. Over half of the panel members indicated they obtained a major share of the equity capital they used to start farming by working on the family farm. After becoming established on a farm, almost half of the panel farmers received help from the family in the form of usually very favorable terms of credit, gifts, or inheritances. Undoubtedly, without this family help, many of the panel farmers could not have become established in farming or at least would have been less well established.

A study is underway of the credit and capital markets in a four-county area of West Virginia to determine how well they are organized to finance local economic development. Preliminary results indicate little evidence of a shortage of credit, but rather that both population and loanable funds are leaving the area in search of more remunerative employment.

#### C. Short-Term Credit and Financial Management

Non-real-estate debt outstanding, excluding CCC loans, increased \$0.9 billion or 6 percent in 1964, considerably less than the large advances of

about \$1.6 billion or 12 percent in each of the 2 preceding years. Non-real-estate debt is much more volatile than mortgage debt, probably because much of the total non-real-estate debt is extended and repaid each year and hence is more sensitive to current decisions of farmers and lenders than is the total volume of real estate debt.

Non-real-estate debt outstanding January 1, 1965 (excluding CCC loans), was \$17.1 billion. All of the reporting institutional lenders except the Farmers Home Administration showed smaller rises in 1964 than in 1963. FHA loans, made to farm operators unable to obtain adequate financing from private or cooperative sources, increased 8 percent during 1964, slightly more than the 7-percent increase a year earlier. Debt owed to banks, the largest non-real-estate lender, increased only 5 percent, compared with an 11-percent rise during 1963. Loans of the cooperative production credit associations were up 8 percent in contrast to a 14-percent rise the previous year.

Regionally, the slowdown in growth in outstanding non-real-estate debt during 1964 was most marked in the Corn Belt, the Northern Plains, and the Pacific production regions. A number of States in these regions showed little change or no increase in this type of debt, while increases of 10-15 percent were common during 1962 and 1963. Debt growth also slowed considerably in the Northeast and Lake States.

Outstanding non-real-estate debt continued to rise at about the same rapid rate as in 1963 throughout most of the Southern areas. Increases during 1964 in States in these areas ranged mostly upwards from 10 percent, or about twice the national rate. The slower growth in non-real-estate debt in some areas apparently resulted largely from the unfavorable cattle situation during part of 1964. Reflecting favorable price prospects in 1965, cattle feeders by the middle of the year had increased the number of cattle on feed by 9 percent above a year earlier. With prices of feeder cattle also rising strongly, the amount of non-real-estate borrowing appeared likely to expand more rapidly again.

A study was published during the year showing the effect of the low potato prices and farm incomes in Aroostook County, Maine in 1953-63 on the volume of farm loans of different financial institutions. Lending by the Farmers Home Administration expanded greatly. The ratio of FHA non-real-estate loans to the combined total of non-real-estate loans held by commercial banks, the production credit associations, and the FHA, rose from 12 percent in 1953 to 47 percent in 1963.

Because of the further rise in debt and increased concern over the financial situation of farmers who borrow heavily, two studies were started during the year designed to provide additional measures of the soundness of the debt situation, and to uncover the reasons for some farmers being overwhelmed by their indebtedness. A study of the quality of short- and intermediate-term loan was begun using data from published or internal sources of loans of production credit associations and non-real-estate

loans of the Farmers Home Administration. For both the production credit associations and the Farmers Home Administration, the data indicate a small decline in the rate of repayments over the last several years. Moreover, both types of institutions apparently have made an increasing proportion of their loans to refinance debts. Both of these developments suggest that farmers may be finding it somewhat more difficult to meet their short-term obligations. However, the declining rate of repayments may be due largely to an increasing proportion of loans made for capital purposes. Capital loans naturally liquidate more slowly than loans for current operating expenses.

A study was begun in South Dakota of "heavily indebted" borrowers from the Farmers Home Administration and production credit associations designed to show the reasons why these debt difficulties had developed. The major part of the field work for this study was completed during the year.

In Wisconsin, field work was completed and a report was in preparation on financial management on commercial farms. The report will indicate some of the factors which influence capital investment decisions of farm operators. It will show how well the investments turned out, and the reasons for the good or poor results. Research in this area is needed to assist farmers in meeting their new capital and credit needs.

Further progress was made in Michigan on the financing of modern large-scale farming operations. This study is designed to show the problems farm operators faced, and the methods they followed, in financing the buildup of their operations; and the problems lenders encountered as a result of the increase in capital used in farming and the growing complexity of management problems on farms, and the ways lenders are meeting these problems. The survey of farmers in the study has been completed, and work has started on the survey of lenders.



PUBLICATIONS -- USDA AND COOPERATIVE PROGRAMS

A. Balance Sheet of Agriculture and Financial Outlook

Farm Production Economics Division. 1964. 1965 agricultural finance outlook. AFO-4. 38 pp.

Garlock, F. L., Allen, P. T., Jones, L. A., Scofield, W. H., and Shapiro, H. 1964. The balance sheet of agriculture 1964. AIB 290. 24 pp.

B. Improvement of Farm-Mortgage Credit Facilities

Eitel, V. E. 1964. Characteristics of farm mortgages recorded January 1 through March 31, 1963. ERS-218. 8 pp.

Farm Production Economics Division. 1964. Farm mortgage debt. FMD-3. 7 pp.

Farm Production Economics Division. Farm-mortgage lending experience of life insurance companies, the Federal land banks, and the Farmers Home Administration.

November 1964 FML-13, 8 pp.

May 1965 FML-14, 19 pp.

C. Short-Term Credit and Financial Management

Brake, J. R. and Wirth, M. E. 1964. The Michigan farm credit panel: a history of capital accumulation. Michigan Agr. Expt. Sta. Res. Rpt. 25. 10 pp.

Garlock, F. L. and Allen, P. T. 1964. Revised estimates of non-real-estate farm debt owed to nonreporting creditors and of total non-real-estate farm debt, 1949-64. ERS-191. 5 pp.

Wall, N. J. 1964. Agricultural credit conditions in Aroostook County, Maine. Maine Agr. Expt. Sta. Misc. Rpt. 115. 18 pp.

Wirth, M. E. 1964. Pattern-analytics: a method of classifying managerial types. Michigan Agr. Expt. Sta. Quart. Bul. Reprint, Vol. 47, No. 2, Article 47-16. 33 pp.

## AREA NO. 5. AGRICULTURAL RISKS AND INSURANCE

Problem. Risk bearing is a necessary and costly function of ownership and management in farming because of production hazards and price uncertainties. Expanded research in reducing agricultural risks should prove valuable to farmers in making management decisions, and to Government agencies and private insurance and financial institutions in adjusting their policies to meet farmers' needs.

Research in this field includes possible modifications of existing insurance, credit and taxation policies, which impose excessive burdens when farm incomes are low. It also includes study of alternative means by which farmers can (1) reduce risks by the adoption of new financial and production practices, (2) shift part of the risk to insurance, financial, and Government institutions, or (3) most effectively combine these two approaches.

With rising farm-property valuations, more use of credit, inflation, and greater chance of personal injury, fatalities, and lawsuits (due to accidents arising from increased mechanization and more highway travel), more kinds and larger amounts of property, health and sickness, life, and liability insurance are required by today's farmers. There is considerable variation in premium costs among companies for identical coverages. The increased insurance coverages carried by farm operators require high premium outlays. Figures of from \$1,000 to \$1,500 are not uncommon. Priorities need to be established to aid farmers in allocating a given premium outlay according to need.

### USDA AND COOPERATIVE PROGRAM

A continuing program of applied and statistical research is carried on that involves compilation of data on farm accidents, fire losses, crop insurance, farm and personal insurance, social security, and farmers insurance companies. Analyses are made of the causes of farm fire losses and accidents, the impact of various types of insurance on agriculture, and the effect of social security programs on farm people.

Study is made of (1) the incidence of production risks, as reflected by yield variability and other factors, on the structure, functioning, and growth of farm firms, and (2) various methods of risk bearing that provide guides for decisions on feed and cash reserves, geographical dispersion of production, flexibility of organization, depreciation and tax management, and insurance.

Work is done in Washington, D. C. with informal cooperation of the Federal Crop Insurance Corporation, the Bureau of Old Age, Survivors, and Disability Insurance, insurance trade associations, farmers mutual insurance companies, State insurance commissioners, and State fire marshals. Work in Montana is done with formal cooperation of the Agricultural Experiment Station and with

a Great Plains regional committee studying Federal Crop Insurance. Work on the relationship of risk-bearing to growth of firms has been initiated in Kansas with formal cooperation of the Kansas Agricultural Experiment Station.

The program currently involves a total of 5.2 Federal professional man-years: Improvement of farmers' mutual fire, windstorm, and crop-hail insurance company operations, 1.2 man-years; organized farm fire protection and estimation of annual farm fire losses, 0.8 man-years; casualty and life insurance (including social security) and accident prevention for farmers, 1.9 man-years; and analysis of risks and risk-bearing in agricultural production, 1.3 man-years.

#### PROGRAM OF STATE EXPERIMENT STATIONS

Research concerned with agricultural risk and uncertainty conducted by State experiment stations is designed to improve the predictability of variations in yields, incomes and prices of major crops and to compare these variations between production areas; to determine the income stability of cropping systems; and to compare alternative methods of estimating yield, income and price variations. Studies are also attempting to determine the reasons for and causes of failure of farm loans and develop procedures whereby farmers and lenders might more accurately predict risks in prospective credit use.

Research on insurance is concerned mostly with insurance strategy to meet the risk and uncertainty associated with agricultural production. The objectives of these studies are to investigate farmers' attitudes regarding the use of crop insurance and other strategies to reduce farm income variability due to weather hazards, and to evaluate the effect of alternative crop insurance programs and select organizational strategies with respect to financial survival and capital accumulation.

A total State effort of 1.3 professional man-years is devoted to this area of research.

#### PROGRESS -- USDA AND COOPERATIVE PROGRAM

##### A. Improvement of Farmers' Mutual Fire, Windstorm, and Crop-Hail Insurance Company Operations

Hail insurance on crops is being bought by farmers in increasing amounts and totaled \$2.9 billion in 1964 compared to \$1.9 billion in 1954. Producers want higher financial protection mainly because of increased cash costs and debts. Premiums paid were \$110 million and crop losses reimbursed were \$68 million. About a third of all insurance is on corn and a half the total is in the Corn Belt. Heaviest losses were on wheat in the Northern Plains.

A study of farmers mutual fire insurance companies showed a continued trend toward fewer and larger companies that are insuring more and more nonfarm property. Small companies are relatively disadvantaged in that their costs



are comparatively high and they must keep larger reserves because of greater year-to-year variation in losses.

#### B. Organized Farm Fire Protection and Estimation of Annual Fire Losses

Farm losses from fire and lightning were estimated at \$193 million for 1964, a record high. Limited data on insurance losses indicate that damage of \$1,000 or more occurred in only 5 percent of the cases. More than half the losses were less than \$50. Adjusting small losses is expensive for insurance companies and suggests that deductible policies might be most economical for both insurers and farmers.

#### C. Casualty and Life Insurance (Including Social Security) and Accident Prevention of Farmers

An analysis of social security records showed that nearly 1.2 million self-employed farmers were entitled to benefits in 1962. This is about a third of all who paid social security taxes since 1955 when farmers were first covered. Benefits are high compared to amounts paid in because farmers are a relatively older group and many retired soon after enrolling in the program.

A report describing the new "Medicare" law and its importance to farm and rural people has been prepared for distribution to economists and others. The significance of the new law to farmers is highlighted by the fact that only 41 percent of those 65 years or older have hospitalization insurance compared to 58 percent for urban people, and 47 percent for rural nonfarm people. Also, relatively more farmers than nonfarmers are 55 years or older.

The rate of fatal accidents on farms has increased recently. Machinery is the most important cause, killing more people on farms than in mines, quarries, and industrial places combined. Accident fatality rates increased rapidly beginning with age 50 and were double the average rate for those over 75. Deaths resulting from falls were more important with increasing age.

Preliminary analysis of the 1961 expenditure survey shows that expenditures of farmers for personal insurance averaged about \$200. Highest average expenditures of \$300 were in the West, about twice the average for the South. Insurance expenditures generally were related to income, averaging less than \$100 for the lowest income class and nearly \$590 for the highest income class.

#### D. Analysis of Risks and Risk-Bearing in Agricultural Production

Wheat yields by counties for 9 Great Plains States were assembled for years 1949-62 to show year-to-year variability of production and changes in yields from similar data available for 1926-48. Yield trends were upward for most counties but increases were more pronounced in the Northern and Central

Plains which experienced severe drought in the 1950's. Technological advances and improved management have helped reduce the effects of unfavorable weather. Year-to-year variability was less in 1940-62 than in 1926-48 in much of the Northern and Central Plains but was greater in eastern Nebraska, eastern Kansas, and in large areas of Oklahoma and Texas.

Study of longtime yield histories for individual farms in Montana indicates that actuarial periods for establishing Federal Crop Insurance rates must be as long as 20 years or more in the Great Plains. "Bunchiness" of wet and dry years shows that short periods are not an adequate basis for crop insurance rates. Farmers' needs for insurance coverage are being studied by relating selected farm budgets to individual yield histories.

Montana personnel also have participated in a Great Plains regional project initiated to improve the operation of Federal Crop Insurance. A paper on the theory of crop insurance was prepared and presented at a regional workshop. Five other papers covering other aspects of Federal Crop Insurance were presented by other Great Plains participants.

PUBLICATIONS -- USDA AND COOPERATIVE PROGRAM

A. Improvement of Farmers' Mutual Fire, Windstorm, and Crop-Hail Insurance Company Operations

Jones, Lawrence A., and Larson, Donald K. 1965. Economic impact of Federal Crop Insurance in selected areas of Montana and Virginia. Agr. Econ. Rpt. 75. 36 pp.

B. Organized Farm Fire Protection and Estimates of Annual Farm Fire Losses

Reinsel, Edward I. 1965. Farm fire losses and farm mutual company operations. Mimeographed. 2 pp.

C. Casualty and Life Insurance (Including Social Security) and Accident Prevention for Farmers

Perkinson, Leon B. 1965. Fatal accidents on farms. ERS-245. 7 pp.

Reinsel, Edward I., and Ellickson, John C. 1965. Farmers and social security. Agr. Fin. Rev. 26, pp. 32-41.

Reinsel, Edward I. 1965. Agricultural economics is an inexact science. Jour. of Farm Econ. 47(3), pp. 849-851.

D. Analysis of Risks and Risk-Bearing in Agricultural Production

Jones, Lawrence A. 1965. Farming risks and uncertainties. 1965 Agr. Fin. Rev. 26, pp. 13-20.



## AREA NO. 6. FARMLAND VALUES AND VALUATION

Problem. Farm real estate is the largest single productive asset in agriculture and has a current market value of nearly \$160 billion, or two-thirds of all agricultural assets. Trends in market values of this asset, and reasons for such changes, are of continuing interest to land owners, prospective purchasers, public and private credit institutions, industries serving agriculture, local governmental units and Federal agencies. Both public and commercial lenders need current information as to the numerous economic forces that have contributed to past trends and current levels of land prices as a basis for formulating and modifying their credit policies. Farm programs often have widespread and pervasive effects on land values, and changes in programs need to be continually evaluated regarding such effects.

The continuing tendency for land values to advance without apparent support from farm income underscores the need for more intensive research as to the respective roles of both agricultural and nonagricultural forces in the land market. Within the agricultural sector, a better understanding is needed of changes in the relationship of land income to total income, and the manner in which technological developments influence farm size and the demand for land for farm enlargement. Interactions between the land and capital markets and the effects of generally abundant credit upon land prices deserve continued attention to provide more effective guides for credit policies. The rural land market also is reflecting the effects of the disappearance of clear-cut distinctions between the farm and nonfarm economies. Forces outside the farm firm have increasingly become partial determinants of land prices over wider geographic areas as metropolitan areas expand, and as improved transportation facilities expose larger areas to the impacts of population growth. Present and potential demands for land as space, rather than solely as a productive resource for agricultural uses, need to be more adequately recognized and evaluated if useful and realistic projections are to be made of future trends in land prices.

## USDA AND COOPERATIVE PROGRAM

The work involves a continuing program of applied research designed to obtain current information on various aspects of the farm real estate market at the State and national levels. Statistical series are developed and maintained to measure periodically changes in market values of farm real estate, rates of farm transfers by various methods, sources and terms of credit used in financing land transfers, and sources of the demand for, and supply of, farmlands that come on the market. Two mail surveys are directed annually to farm real estate brokers and other informed people to obtain such basic information. These data, together with the responses

to various opinion questions, and the estimates of market values obtained from USDA crop reporters, are summarized and analyzed in periodic reports issued twice a year. The content of the semi-annual surveys has been broadened in recent years to include the rural nonfarm sector of the land market, such as sales of farms for nonfarm uses, and prices of land for various recreational uses.

The market-developments phase of the research program outlined above is supplemented by special studies on selected aspects of the rural land market such as farm building valuation, appraisal procedures and techniques, and alternative measures of land returns. Liaison is maintained with Federal and private credit agencies, and with private real estate sales and management organizations, by which survey and research results are made available to them in exchange for the information they provide.

The Washington-based research program is supplemented from time to time with cooperative studies with State experiment stations designed to examine specific facets of the farm real estate market in greater depth than is possible at the national level. Three such studies are presently being initiated at South Carolina, Louisiana, and California and will be concerned with developing alternative measures of returns to land used in cotton production, and with the effects of farm enlargement purchases.

Annual estimates of gross and net rents paid for rented land represent another continuing research project at the national level. Such estimates are needed in calculating net income of farm operators by USDA and are incorporated in the national income accounts of the Department of Commerce. Rents also provide an independent measure of rates of return to farmland and a useful analytical tool in the continuing study of land prices.

About 2.1 Federal professional man-years are currently devoted to all phases of the research program in farmland values and valuation. Of this total, about 1.5 man-years are allocated to the current market developments phase of work, and 0.5 man-years to analysis of factors affecting land values and transfers. Lack of personnel limits work on farm real estate rentals to 0.1 man-years.

#### PROGRAM OF STATE EXPERIMENT STATIONS

Several studies are under way in the various regions to investigate the factors and forces influencing the rise in land values that has occurred in most parts of the Nation. The objectives of studies of this type in the Northeast are to determine the numbers and rates of farm transfers, the prices and sizes of farms transferred, methods of financing, and past and future land use patterns. Research being conducted in the South is concerned with the influence of Government tobacco and peanut programs on land values and the effects of nonfarm land use on farmland prices.



In the North Central and Western regions several studies are under way to determine the effects of size of tract, land productivity, location, accessibility, land use, method of transfer, type of farming, and other factors associated with variations in land prices. The station effort in this area of research amounts to 3.4 professional man-years.

## PROGRESS - USDA AND COOPERATIVE PROGRAM

### A. Current Developments in the Farm Real Estate Market

Market values of farm real estate continued to advance throughout 1964. On March 1, 1965, the index of average value per acre was 139 (1957-59=100), 6 percent higher than on March 1, 1964. All States showed increases, ranging from 3 or 4 percent in several States in New England and in the Mountain and Pacific States, to 8 percent or more in most States in the southern half of the country. Basic indicators of supply and demand in March 1965 differed little from a year earlier. The market supply of land continued limited, while demand continued generally strong, supported in part by an adequate supply of credit.

The total market value of farm real estate on March 1, 1965 was estimated at \$159.4 billion, up \$8.6 billion from a year earlier. With a further decline in number of farms, the average value per farm also reached a new high of \$52,200, about \$4,000 more than a year earlier.

The rate of voluntary sales in the year ended March 1, 1965 was 4 percent below the rate for the preceding year. The rate of farm foreclosures, at 1.4 per 1,000 farms, was a little lower than the previous year. Land buyers continue to be chiefly farmers, mostly those enlarging their present farms. About half of all sales in 1964-65 were for this purpose. Farmers buying additional land were older, and were operating larger acreages, than buyers making their first purchase. About one-third of all buyers were nonfarmers, but half of them intended to operate the land they acquired, either as full-time or part-time farmers.

Sellers remain the largest single source of credit for financing land purchases, accounting for 39 percent of all credit sales in 1963-64. Nearly three-fourths of such seller-financed sales were by land contracts. Among commercial lenders, banks continue to be the most frequent source of funds, financing 18 percent of all credit sales, followed by insurance companies at 14 percent and Federal land banks at 9 percent.

### B. Analysis of Factors Affecting Land Values and Transfers

A special study was completed to test the general hypothesis that the increase in land values over the past decade may have been supported by an increase in land earnings even though net farm income had not increased appreciably. A method of allocating farm income to operator and family labor, management, and nonreal estate capital was developed to obtain a



residual return to land and service buildings. This measure of land earnings has increased since the mid-1950's, both in terms of dollars per acre and as a percentage of total farm income. Thus, while total net income per acre in 1964 was only 7 percent higher than in 1954, land income (after the management charge) was about 58 percent higher. Although this increase is still less than the 74 percent gain in land prices, the results indicate substantially more income support for the rise in land prices than does net income to all factors.

The rising share of net farm income allocable to land is due chiefly to the decline in number of farm operators and in man-hours needed in farm production. Fewer and larger farms mean that fewer farm families have a claim against the total income package. Per-acre costs for such labor and management charges are reduced because of the larger acreages handled by each operator -- a type of "economy of scale" similar to the savings realized by spreading overhead costs for farm machinery and equipment over more acres.

The study also examined trends in the gross value of crop production per acre, and the magnitude of Government payments per acre. The gross value of crop output increased 28 percent between 1954 and 1964, partly as a result of higher yields and partly from the removal of about 45 million acres of cropland, some of which was of below average productivity.

The increase in Government payments was shown to have maintained net income per acre at a relatively constant level since the mid-1950's, rather than resulting in an actual increase in income. Areas that have received the largest increases in payments over the past decade show smaller-than-average increases in land prices. Although allotments have been shown to be capitalized into the value of land used for allotment crops, the studies to date have not determined the extent to which allotment values have affected the level of all land prices in an area, or the trend in prices over time.

### C. Agricultural Rents

Gross rents were estimated at \$3.7 billion in 1964, about the same as in 1963. Cash rents continued to advance, but the value of share rents was a little lower. Landlord's expenses for real estate taxes and building repairs and depreciation were a little higher. The slight decline in net rents, along with the further increase in market values, reduced the net rate of return from rented land below 3.5 percent in 1964.

PUBLICATIONS - USDA AND COOPERATIVE PROGRAM

A. Current Developments in the Farm Real Estate Market

Farm real estate market developments. CD-67, Aug. 1965. 55 pp.

Scofield, W. H. and Pressly, T. J. 1965. Farm real estate values in the United States by counties, 1850-1959. University of Washington Press. 69 pp.

B. Analysis of Factors Affecting Land Values and Transfers

Gale, J. F. 1965. How much is a crop allotment worth? The Appraisal Journal, July 1965, pp. 370-376.

Scofield, W. H. 1965. Land prices and farm earnings. The Appraisal Journal, Jan. 1965, pp. 100-113.

Scofield, W. H. 1965. Land returns and farm income. Farm real estate market developments. CD-67, pp. 44-54.

Scofield, W. H. 1964. Dominant forces and emerging trends in the farm real estate market. Paper, Seminar on Land Prices, North Central Regional Land Economics Committee, Chicago, Nov. 1964. 12 pp.

C. Agricultural Rents

None.

## AREA NO. 7. ECONOMICS OF FARM PRACTICES AND TECHNOLOGY

Problem. New and rapidly changing technology is having profound effects on agriculture. Ever-changing conditions of production brought about by new machines, new-type structures and related equipment, and improved methods of crop and livestock production require continual economic study to provide farmers, policy makers, and industries serving agriculture with guidelines for decision in a changing economic environment. Such studies need to measure and keep abreast of major changes in farming technology and must appraise the implications of these changes for the future. These studies should include analyses to provide information needed by farmers in different situations as they adjust to changing conditions of technology, prices, and costs. They should also include analyses aimed at guiding policy makers and program administrators as well as at helping industry to meet better the needs of farmers.

### USDA AND COOPERATIVE PROGRAM

This is a primarily applied research, consisting of a continuing program of collection and analysis of data bearing on national situations and of the study of certain important innovations in farm practices and technology. Included is the development of aggregative measures of the effects of technological changes on farm output, costs, and income.

More specifically, the work involves the collection of pertinent data and the economic analysis of developments in farm mechanization and structures; in the use and effects of fertilizer, pesticides, and related crop practices; and in the production and utilization of livestock feed. These activities center in Washington, D. C. and consist mainly of broad national studies dealing with both the supply aspects and the demand aspects. They usually involve at least informal cooperation of other USDA agencies, particularly the Statistical Reporting Service and the natural science and engineering groups dealing with mechanization, crop practices, and livestock feeding. Research results are normally presented in aggregative terms for areas, States or regions, along with supporting data such as input-output ratios. Intensive studies of narrower scope are made occasionally in selected areas to obtain information to supplement national and regional data from other sources. Such studies are usually in cooperation with State experiment stations, currently in Iowa, Michigan, Nebraska, and California.

The manpower currently devoted to this program is estimated at 8.4 Federal professional man-years: 1.8 on economics of pesticide use in agriculture, 1.4 on economics of feed use and feed-livestock relationships, 0.8 on economics of farm mechanization and associated techniques, 0.9 on inventory and analysis of production practices (national), 2.1 on economics



of fertilizer use and crop technology, and 1.4 on economics of farm structures and materials handling, including a research contract with Iowa State Univeristy for a survey and certain analyses of farm service buildings.

#### PROGRAM OF STATE EXPERIMENT STATIONS

A considerable segment of research at the State experiment stations is addressed specifically to the economic evaluation of mechanical and biological innovations being adopted by farm operators. However, most of this research is in the various engineering and biological science research statements as well as the other farm management research statements. In the Northeast studies of this type are investigating forage and other materials handling systems on dairy farms, the mechanical harvesting of potatoes and sugar beets and storage and housing structures on dairy farms. In the South research studies are concerned with the economic analysis of innovations introduced into sawmill operations and mechanization of cotton and forage crops. Research in the North Central region is designed to economically evaluate technical innovations being introduced into the swine industry as well as alternative systems used in swine production. The number of professional man-years devoted to this area of research by the State stations is incorporated in the quantitative aspects of other research statements.

#### PROGRESS - USDA AND COOPERATIVE PROGRAM

##### A. Economics of Pesticide Use in Agriculture

As part of the Department's expanded research program on pesticides provided for by the Congress for Fiscal Year 1965, the Farm Production Economics Division initiated a new program of research on the economics of pesticide use in agriculture. This research is divided into three major phases: (a) a nation-wide survey of farmers to obtain basic data on costs and practices used to control plant and animal pests; (b) economic analyses of selected alternative methods of pest control on farms with emphasis on innovations to control pests; and (c) analyses of the aggregate economic implications of alternative methods of pest control for agriculture as a whole.

The nation-wide survey of pesticide uses was conducted during March and April, 1965. Farms were selected for enumeration from a probability area sample. Information on pesticide use and pest control practices, farm characteristics, crop and livestock production, and labor use was obtained. A total of 11,384 usable detailed questionnaires were obtained from farms distributed in 417 counties in 47 States. Hawaii and Alaska were not included in the survey and the probability sample did not result in any farms being drawn in Rhode Island. In addition, limited information on

pesticide use and farm characteristics was enumerated on about 23,000 non-qualifying farms. Non-qualifying farms were considered to be those with less than \$2,500 of gross income from agriculture in 12 Southeastern States and less than \$5,000 of gross income in all other States. All data were punched on cards and transferred to tape. The data are now being edited in preparation for tabulation and summarization. About 8,000 pesticide products were coded and the information was incorporated into a tape file. Each product was identified by form and type of pesticide and the percentage of each active ingredient.

In the analysis of alternative pest control methods on farms two studies were initiated in July 1965 in cooperation with State agricultural experiment stations in Nebraska and California. A third study will begin in Michigan in September 1965. The appraisal of the aggregate implications of changes in pesticide use has been limited to a brief review of alternative approaches to the analysis, and a preliminary investigation of the joint relationships in the use of agricultural resources.

#### B. Economics of Feed Use and Feed-Livestock Relationships

Research is carried on at the national level to determine the effects on feeding efficiency of current and new technology in livestock feeding and management. The data have been revised and updated through the 1965-66 feeding year. These studies show that the more moderate feeding rates for hogs and cattle on feed during the 1962-64 feeding seasons have continued during 1964-65 and into 1965-66. Feeding rates for milk cows, already high, continue to increase. Little change is noted in feeding rates for other classes of livestock. Numbers of grain-consuming animal units and high protein animal units remain about the same as in 1964-65. Feed grain-livestock balances by States have been updated through 1964-65. Studies of feed consumption to determine feeding rates for various kinds of livestock in each of the States have been completed. Preliminary computations have been made and a manuscript is being prepared. Preliminary work has been started on a project to determine the present and potential use of urea in livestock feed and its effect on oilseed meal consumption and prices. Representatives of several feed manufacturing concerns have been interviewed to secure necessary background to properly plan this study.

#### C. Economics of Farm Mechanization and Associated Techniques

Research is nearing completion on the aggregate demand for farm tractors. Maximum belt horsepower available to farmers from tractors increased from 200,000 in 1912 to 162,000,000 in 1962. The demand for new tractors evolves from many individual farmers maintaining or adding to their stock of tractors. A single equation regression model is used in this study to explain aggregate tractor horsepower purchases for the United States between 1920 to 1962. Tractor horsepower purchases are expressed as a function of horsepower on hand, crop production, the ratio of the price



received for products sold, size of new tractors purchased, age of tractors, and the number of farms.

The elasticity of demand for tractor horsepower purchases with respect to the real price of tractors, (ratio of tractor prices to prices received for farm products sold) ranges between 1.7 and 2.7. The differences between the short-run and long-run elasticities suggest that 89 to 93 percent of the adjustment is completed in the first year. This elasticity of demand with respect to the real price of tractors is lower in recent years.

Projected purchases for 1970 are about 8 million horsepower (maximum belt horsepower), up from about 7 1/2 million in 1962, if the following conditions prevail: (1) crop production increases about 15 percent (index of crop production 1957-59=100 up from 108 to about 124), (2) the price of tractors relative to prices received for farm products sold increased about 7 percent (index of tractor prices divided by the index of prices received 1957-59=100 up from 110 to 118), (3) size of tractors purchased increased from 54.5 to 80.0 horsepower, and (4) the number of farms decreased from 3.7 million to 3.3 million. The number of tractors sold in 1970 will be about 100 thousand units, down from 150 thousand units in 1962. A wide variation in projected purchases results from considering relatively small differences in the independent variables. However, changes in these variables tend to offset each other.

#### D. Inventory of Production Practices

A national survey of methods of distributing fertilizer in 1962 shows that 13 percent of the total solid fertilizer was spread by motor truck compared with 8 percent in 1954. Much of the fertilizer applied with other broadcast spreaders is delivered to the farm in bulk. The importance of broadcast spreaders increased from 27 percent to 31 percent between 1954 and 1962, but the fertilizer distributed with grain drills declined from 18 to 14 percent. Although there is evidence of some decline in the application of fertilizer at planting time in favor of broadcast spreading, nearly half of the fertilizer was applied at planting in 1962. The remainder was about equally applied before planting and after crops were planted.

A national survey of methods of handling forage in 1963 shows that 60 percent of all silage was stored in upright silos, 35 percent in trench and bunker silos, and 5 percent in temporary silos. About 60 percent of the silage was hauled to the silo in self-unloading wagons or trucks. More than a third of the silage was removed from upright silos with mechanical unloaders in 1963 compared with only 5 percent in 1955. In 1963 upright silos accounted for only 70 percent of the total number compared with 90 percent in 1950. However, the present trend in construction may be toward more upright silos. While one season is not adequate evidence, 15 percent of the upright silos were not filled in 1963 while 25 percent of the trench silos remained empty. Handling hay with bale throwers



increased from 3 percent of the baled hay in 1961 to over 6 percent in 1963. Another 40 percent of the baled hay was loaded in the field with mechanical equipment.

A summary of data from a national survey of the extent of custom work and machine rental in 1964 is available for three regions: The Lake States, the Corn Belt, and the Northern Plains States. Crops in these 12 States represent over half of the total acreage in the United States. Results for major areas of custom operation (harvesting and storage) show 25 to 35 percent done by custom or exchange machines. In tillage operations custom work is not important yet. But for hauling and feed grinding over half of the tonnage is transported or processed with custom or exchange machines.

In 1964, on the basis of 1,000 farms, the following machines were rented or leased: 25 fertilizer distributors, 15 sprayers, 12 tractors and 6 trucks. In addition, 45 other machines ranging from 4 per 1,000 farms to a listing of the more uncommon ones, were rented or leased.

Work plans for estimates of fertilizer use by crops, based in part on 1964 census data, have been completed. These estimates, like similar ones for census years 1954 and 1959 will provide published benchmark data widely used in research and for general distribution.

In collaboration with the Statistical Reporting Service, arrangements were made for release of annual estimates of fertilizer use on corn, cotton, wheat, and soybeans in States where these crops are important. The 1964 estimates by States for these crops have been prepared in a manner suggested by this Division. They are being reviewed by SRS and will be released soon.

#### E. Economics of fertilizer Use and Crop Technology

Earlier work on development of fertilizer--yield coefficients for use in aggregative analysis is being integrated with the nation-wide survey of conservation needs. The latter, supplemented by estimates of State committees, will show the average distribution of all important crops by soil groups and by State parts of agricultural sub-regions. Coincident with this, base yields per acre for each crop by soil groups will be developed by the Soil Conservation Service. This provides a nation-wide basis for developing estimates of yield ratios associated with different levels of fertilizer use, relative to the base yields. Yield relatives established in this way can be adapted to any current levels of actual yield to arrive at estimates of yield response to fertilizer suitable for aggregative analysis.

Appraisals of the current and projected aggregate economic position of fertilizer use in the U. S. have been made by projecting recent relationships between changes in the index of crop production per acre and in

fertilizer use per acre of cropland. At recent rates of application, the analysis indicates marginal returns per dollar cost of fertilizer in the aggregate that range from about \$1.50 in the Southeast and in the Corn Belt, to about \$7 in the Northern Plains, with the U. S. average at \$2.50.

Economic substitution of fertilizer for land at 1960-64 average rates ranged from about 3 acres per ton of plant nutrient elements (NPK) in the Southeast to 55 acres in the Northern Plains, with the national average at 9.4 acres per ton. At 1960-64 average technology, maximum attainable crop production per acre in the aggregate through increased use of fertilizer is estimated at about 2.5 times that of the base period, for the U. S. as a whole.

Assuming variable costs exclusive of fertilizer at \$25 per acre of cropland, to equalize marginal returns on all variable costs, rates of N would need to be 3 times the 1960-64 average; rates of P and K would need to be double those of this base period. These could be regarded as minimum economic rates as they are associated with minimum cost per unit of crop production, at the assumed level of other variable costs. Crop production per acre would be increased by 30 percent, and the U. S. aggregate marginal rate of substitution of NPK for land at that point would be 5.75 acres per ton. The minimum variable cost per unit of crop production would occur at these increased rates, indicating that aggregate substitution of fertilizer for land would be increased to this point in order to obtain the minimum unit cost of crop production, if costs per acre exclusive of fertilizer are taken as \$25.

Maximum economic rates of application in the aggregate (for most profit per acre) would be 9.5 times greater for N, 5.8 times for P, and 9.2 times for K, relative to the 1960-64 acreage resulting in aggregate crop yields per acre 1.9 times those of the base period. Leading individual farmers are now applying such rates and obtaining such relative yields for some crops.

About one-fifth of the increase in crop production per acre between the 1955-57 and 1962-64 periods may be attributed to the increase in rates of NPK per acre. The remainder must be attributed to changes in technology other than fertilizer rates, shifts in crop production to more productive lands, weather, and complementary effects of all factors.

Projecting relationships between crop production per acre and rates of NPK per acre to 1980, and accepting the Department's projection of crop production needs by that time, the analysis indicates a combination of 278 million acres of cropland, 14 million tons of N, 3.2 million tons of P, and 7.5 million tons of K. At the U. S. level the index of crop production per acre would be 160, 1960-64=100. This compares with the 1960-64 average of 339 million acres, 3.4 million tons of N, 1.2 million tons of P, and 1.9 million tons of K. The Department's projected index of total crop production needs for 1980 is 136, with 1960-64=100.

#### F. Economics of Farm Structures and Materials Handling

The research on the aggregate investment expenditure on farm buildings is nearing completion. The material has been presented as part of a doctoral dissertation, and a draft of a publication has been proposed to present the results.

National, regional, and State levels of aggregation are used in estimating demand functions. The demand functions are for annual expenditures on new farm buildings and remodeling, and include both farm housing and farm service buildings. The important variables identified by the study include farm income, the rate of interest on new farm mortgages, the ratio of long-term debts, and a time trend. In the national models, both gross and net income were considered separately, but in the State models only gross income was considered because of the availability of data.

As economic theory would suggest, income has a positive effect, interest rate a negative effect, and the asset-to-debt ratio a positive effect upon farm building demand. The time trend has a negative effect upon aggregate investment in farm buildings.

The elasticities of demand with respect to income were most important in indicating the relative change in farm building investment because of the greater magnitude and variation of income compared to other explanatory variables. The elasticities with respect to gross income were largest, ranging from 0.48 to 0.75 on national data depending on the specific variables included in the equation. These elasticities indicate the strong influence a change in output has on building capacity requirements. Elasticities with respect to net income for national building investment ranged from 0.20 to 0.43. Elasticities with respect to equity-ratio (ratio of long-term assets to long-term debts) ranged from 0.36 to 0.67, and elasticities with respect to the ratio of the interest rate to building cost ranged from -0.01 to -0.23.

Regression models were used to make projections of demand for farm buildings on national, regional, and State basis for the year 1980. These projections suggest a moderate decline in farm building expenditures in real terms, not only for the Nation, but for all regions and nearly all States. The expected increase in size and decrease in number of farms appear to be the primary causes of the projected decline in new investment in farm buildings.



PUBLICATIONS - USDA AND COOPERATIVE PROGRAM

A. Economics of Pesticide Use in Agriculture

Davis, V. W. 1965. Nation-wide study of pesticides use in agriculture. Statistical Reporter. No. 325, p. 5.

Sundquist, W. B. 1965. Economic research on pesticide use. Minnesota Farm Business Notes. No. 472, pp. 1 and 3.

B. Economics of Feed Use and Feed-Livestock Relationships

Hodges, Earl F. 1964. Supplement for 1964, livestock-feed relationships, 1909-1963. Stat. Bul. No. 337. 32 pp.

Hodges, Earl F. et. al. 1965. Feed use of urea in the United States (an administrative report). 27 pp.

Hodges, Earl F. 1965. Supplement for 1965, livestock-feed relationships, 1909-1963. Stat. Bul. No. 337. 31 pp.

C. Economics of Farm Mechanization and Associated Techniques

None.

D. Inventory of Production Practices

Danielson, L. L., Ennis, W. B., Jr., Klingman, D. L., Shaw, W. C., Timmons, F. L., Jernigan, J. E., Paulling, J. R., and Strickler, P. E. 1965. A survey of extent and cost of weed control and specific weed problems. ARS 34-23-1. 78 pp.

E. Economics of Fertilizer Use and Crop Technology

None.

F. Economics of Farm Structures and Materials Handling

None.

## AREA NO. 8. FARM COSTS AND RETURNS

Problem. In this period of rapid change in American agriculture, it is important to have comprehensive, reliable, current and historical data on representative or typical farms in major commercial farming areas of the United States. Physical and economic data needed include: Farm size, land use, livestock numbers, production, investment, prices received and quantities sold, prices paid and quantities purchased, and net returns. Such information is essential for intelligent policy and operating decisions by the agencies and industries serving agriculture and by farmers themselves.

### USDA AND COOPERATIVE PROGRAM

Costs and returns by major types of farms is a continuing study of operations of typical or representative commercial farms to determine changes in size of farm, organization, investment, productivity, receipts, expenses, net farm income, physical inputs, farm output, prices received for products sold, and prices paid for goods and services used in production. Budgets are prepared annually to provide current information. Estimates for earlier years are revised as new information becomes available. Analyses are continually underway to show the effects of economic and technical changes on land, labor, and capital requirements, production, production efficiency and incomes of typical or representative commercial farms. Nearly all the work is done in Washington with informal cooperation with States where the studies are located. Formal cooperation is maintained with the Iowa, Kentucky, Maine, and Tennessee Agricultural Experiment Stations and is being developed with several others.

A total of 7.5 Federal professional man-years were devoted to all costs and returns work.

### PROGRAM OF STATE EXPERIMENT STATIONS

Research in this area constitutes a major segment of the applied farm management research underway at the State stations. The results of these studies provide practical information for decision makers relative to the effects of types of enterprises, enterprise combinations, level of output and resource efficiency on costs and returns in farming. In the Northeast, costs and returns analyses are being determined for the production of milk, maple products, floriculture products, eggs, and other major and minor commodities common in the region. States in the Southern region are conducting costs and returns analyses for the production of rice, milk, forage crops, cotton, forest products, citrus crops, swine, beef, sheep, tobacco, and vegetables. These analyses also include coffee and other selected crops produced in Puerto Rico. The costs of irrigation systems, fertilizer applications, and management practices are also being investigated. Studies are being conducted in the Midwest to determine costs and returns for major crop and livestock enterprises common to the region. In addition, economic analyses are

being made of soil management practices, feeding systems, fertilizer rates, and the aerial application of pesticides. Studies in the Western region are concerned with the cost of high lift pumping systems used in irrigated farming, the cost of producing sugar beets, and the economic analysis of replacement decisions for machinery, fruit trees, and dairy cows. A total of 30.3 professional man-years is being devoted to this area of research.

## PROGRESS -- USDA AND COOPERATIVE PROGRAM

### A. Costs and Returns by Major Types of Farms

Estimates for 1964 bring up to date the continuing series on costs and returns of typical commercial farms in the major producing areas of the United States. The report for 1964 covered 42 types of farms, two more than in the previous year. New series were added for sheep ranches in western Utah and east central Nevada, specialized broiler farms in Delmarva, and spring wheat-fallow farms in northwestern North Dakota and adjacent areas in Montana.

Typical sheep ranchers in the Utah-Nevada area are represented by 2-band, desert-operated units. They follow a pattern of grazing at successive grazing areas throughout the year and are commonly referred to as migratory units. Specialized broiler operators in Delmarva produced approximately 53,000 birds per farm in 1964 as their sole enterprise. This series supplements one for broiler-crop farms in the same area and helps better to describe and understand broiler production. The spring wheat-fallow farm represents an important spring wheat area in the Northern Plains transition zone. It replaces a series on wheat-roughage-livestock farms in North and South Dakota.

The historical series for tobacco farms in the Coastal Plain of North Carolina, and for hog-beef-fattening farms and hog-dairy farms in the Corn Belt were revised using data from enumerative field surveys and census schedules.

In cooperation with the Kentucky and Tennessee Agricultural Experiment Stations, an enumerative field survey was made on tobacco farms in the Pennyroyal. Preliminary tabulations of these data and of data from the 1954 and 1959 censuses indicate that two types--tobacco-dairy farms and tobacco-beef farms--are common in this area. Burley, dark air-cured, and fire-cured tobaccos are grown in this area. However, in most cases only two of the three types are produced on an individual farm. Beef production is largely a cow-calf operation and most of the dairy production is for manufacturing.

Enumerative field surveys were also made on Grade B dairy farms in eastern Wisconsin, on wheat-corn-livestock farms and on wheat-grain sorghum-livestock farms in the Northern Plains, and on tobacco-livestock farms in the Bluegrass of Kentucky. Data from these surveys were used to update information on crop and livestock practices, machinery inventories and farm expenses.



In 1964, net farm incomes averaged lower than in 1963 on 23 of the 42 types of farms; incomes were higher on 18 and about unchanged on one. Income changes from 1963 to 1964 ranged from a decline of 84 percent for nonirrigated cotton farms in the High Plains of Texas to an increase of 146 percent for cotton-specialty crop farms in the San Joaquin Valley of California. The decline in returns on the Texas farms resulted from poor yields, while higher prices received for potatoes were largely responsible for increased returns on the California farms.

Changes in farm production and in prices received for products sold were the major factors affecting incomes on typical farms in 1964. All the farm types with lower incomes in 1964 had lower production, lower prices received, or both. On farms with higher incomes, production increased on all except sheep ranches in Utah-Nevada which realized a 6-percent gain in average prices received in 1964.

Prices paid for goods and services used in production averaged higher than in 1963 on 29 of the 42 types of farms. They were lower in 1964 on 9 and unchanged on 4 types.

In 1964, operating expenses increased on 27, declined on 14, and were unchanged on one of the 42 farm types. Increases in operating expenses were generally due to higher prices paid, growth of operations and more intensive use of inputs. Declines in prices paid were accompanied by lower operating expenses on only 4 farm types, while on 5 types of farms operating expenses increased despite lower prices paid.

Net farm incomes on 31 of 41 types of farms in 1964 were from 1 to 89 percent above the 1951-60 average. Net incomes on the other 10 types of farms were from 1 to 69 percent below the average. Higher incomes compared with the 10-year average reflect increased size of farm and operations, higher crop yields, greater livestock production, and improved practices and efficiency. In general, price-cost relationships were less favorable than in the earlier period. On most farms prices received have declined and prices paid have trended upward. However, both production per farm and production per unit of input have increased.

The annual outlook issue of the Farm Cost Situation was published in November 1964. It summarized significant developments and outlook implications in the use and cost of the major farm production inputs. It also contains a summary of costs and returns on 8 types of farms selected to represent the major types in the United States. This issue indicated a further rise in farm production expenses for 1965, including increases in expenses for feed, livestock, fertilizer, interest, taxes, and depreciation of capital items. Discussed in addition were resource savings from the increasing productivity of agriculture, a very substantial item in the past few decades.

PUBLICATIONS -- USDA AND COOPERATIVE PROGRAM

A. Costs and Returns by Major Types of Farms

Cummins, D. E. 1965. Costs and returns, commercial dairy farms, Northeast and Midwest, 1964. FCR-30. 10 pp.

Economic Research Service. 1964. The farm cost situation. 1965 Outlook issue. FCS-36, pp. 31-42.

Goodsell, W. D. and Gray, J. R. 1965. Costs and returns, western livestock ranches, 1964. FCR-27. 21 pp.

Goodsell, W. D. and others. 1965. Farm costs and returns, commercial farms, by type, size, and location. AIB 230 (revised). 97 pp.

Hole, E., Strand, E. G., and Csorba, J. J. 1965. Costs and returns, commercial cotton farms, 1964. FCR-32. 12 pp.

Hurd, E. B. 1965. Costs and returns, commercial wheat farms, Pacific Northwest, Northern Plains, and Southern Plains, 1964. FCR-31. 16 pp.

Rosenberry, P. E. 1965. Costs and returns, commercial Corn Belt farms, 1964. FCR-34. 6 pp.

Shugars, O. K. and Bondurant, J. H. 1965. Costs and returns, commercial tobacco-livestock farms, Bluegrass area, Kentucky, 1964. FCR-28. 9 pp.

Shugars, O. K. 1965. Costs and returns, commercial tobacco farms, Coastal Plain, North Carolina, 1964. FCR-29. 17 pp.

Stoddard, E. O., II, and Jewett, L. J. 1965. Costs and returns, commercial broiler farms, Maine, Delmarva, and Georgia, 1964. FCR-33. 20 pp.

## AREA NO. 9. FARM LABOR UTILIZATION AND PRODUCTIVITY

Problem. The utilization of human effort in farm production has changed greatly in recent decades and will likely change even more rapidly in the years to come. Technological and other economic developments increase the productivity of individual workers and make possible a decrease in the number of persons engaged in farmwork. But these developments require higher levels of skill and knowledge on the part of the persons continuing to do farmwork, while forcing other workers to seek nonfarm employment. At the same time, the increasing attractiveness of nonfarm jobs together with various social and economic changes exert upward pressures on earnings and perquisites in many types of farm employment. Because of the many economic, social, and other changes that affect the utilization of human effort in farm production, a better understanding of these changes is needed to assist in planning for and guiding the human and economic adjustments involved.

### USDA AND COOPERATIVE PROGRAM

Work on farm labor requirements and use is carried on as a continuing program in Washington, D. C. This work is aimed at keeping abreast of farm labor used, nationally and by regions, in total and by major enterprises. Estimates of man-hours of farmwork are prepared annually, based on pertinent secondary data and, when necessary, by field surveys. This series of estimates, going back to 1910, gives a comprehensive statistical picture of what has happened to farm labor requirements over the years.

A continuing program of measuring and analyzing changes in farm labor productivity and efficiency is conducted in Washington, D. C. It provides annual indexes of farm production per man-hour, with breakdowns by regions and by major commodities. The series of estimates provide comprehensive measures of farm labor productivity over the years. Periodically, analyses are made of the past and projected future effects of technological and other developments on production per man-hour and on quantity of labor input used.

Research on the economics of farm labor utilization is conducted. Some of the important long-term developments in U. S. farming have been the substitution of capital for labor, the discovery and adoption of labor-saving technologies of production, the substitution of skilled for relatively unskilled human effort, and the greater rise in farm wage rates than in cost rates of most other inputs. Research to understand these developments and the related farm labor adjustments is for the most part done through special studies in selected situations. Some research is located in



Washington, D. C. and some at field locations. Current projects are cooperative with the State agricultural experiment stations of California, Iowa, and Maine.

The economic relationships between farm operators and hired farmworkers constitutes another line of study. In certain types of farming and geographic regions, hired farmworkers are becoming a relatively larger segment of the farmwork force. Economic relationships between farm operators and hired farmworkers are becoming more complicated and less determined by custom, with the basic character of these relationships also often changing. In addition to their other managerial functions, many farm operators are now of necessity exercising a personnel function in an employer-employee relationship. Such problems are involved here as: Seasonal peaks in labor requirements; the development of workers' skills; training of workers for particular jobs; management of workers; and determination of incentives such as the levels of wages and perquisites (including housing) and of the other terms and conditions of employment. Hired workers likewise find that they may face new or more difficult problems growing out of technologic displacement of old tasks, shifts in areas of production, longer and more frequent periods of unemployment during the year, and the necessity to learn new and more exacting skills and work habits. Some research is located in Washington, D. C. and some at field stations. Field research presently underway is cooperative with the Oregon Agricultural Experiment Station.

A total of 5.0 Federal professional man-years is devoted to this research area, distributed as follows: Farm labor requirements and use, 0.5 man-years; farm labor productivity and efficiency, 1.1 man-years; economics of farm labor utilization, 2.5 man-years; and economic relationships between farm operators and hired farmworkers, 0.9 man-year.

#### PROGRAM OF STATE EXPERIMENT STATIONS

Research studies conducted at State experiment stations dealing with farm labor can be divided into two categories. In the first are studies designed to determine labor requirements and efficiencies for farm production and for the various tasks and functions which constitute total farm operations. In the second, labor studies are concerned with aggregative aspects of labor supply, demand, and utilization.

Studies of the former type are being conducted to determine labor efficiency and cost of alternative feed handling methods on dairy farms; to determine the most effective work methods in the production of poultry, eggs, and vegetables; to analyze the processes involved in hog production in an effort to synthesize work elements into a least-cost system of production; and to compare mechanical and hand methods of vegetable and fruit harvesting.

Labor studies of the aggregative type are underway in three of the four major regions. In the Midwest region supply and demand functions are being estimated for operator, unpaid family and hired labor in agriculture. Studies are also being conducted to determine the impact of industrialization and nonfarm employment opportunities upon the transfer of labor out of agriculture and to analyze the characteristics of the farm labor force which aid or hinder the labor transfers in an effort to develop more effective public and private policies to increase labor mobility. Studies in the West give emphasis to the effects of labor saving technology upon the quantity, types and seasonality of demand for farm labor. In the South labor research is concerned with the magnitude and significance of the farm labor surplus, the demand for farm labor in relation to current and future agricultural adjustments in the region, and the quantitative and qualitative aspects of rural populations relative to employment opportunities in agriculture.

The State stations are devoting a total of 11.3 professional man-years to this area of research.

#### PROGRESS - USDA AND COOPERATIVE PROGRAM

##### A. Farm Labor Requirements and Use

The continuing research on labor requirements and use in farm production indicated that labor used on U. S. farms totalled about 8.4 billion man-hours in 1964. This was below any previous year and 4.5 percent less than in 1963. Of the 1964 total, almost 3.3 billion hours or 39 percent was spent on livestock other than horses and mules, and about 4 billion hours was devoted to crops. Overhead jobs accounted for most of the balance.

Farmwork in the Corn Belt continued to take more time in 1964 than in any other region. However, the percentage decrease from 1963 in this region exceeded the national average. The smallest decrease in use of farm labor from 1963 to 1964 was in the Pacific region, where fruit and vegetable output is important and difficult to mechanize.

##### B. Farm Labor Productivity and Efficiency

The continuing research on farm labor productivity and efficiency shows that farm output per man-hour rose 4.4 percent from 1963 to 1964, to 141 percent of the 1957-59 average. The increase for livestock was greater than for crops, as each kind of livestock outgained most groups of crops. However, of all groups shown, cotton production per man-hour rose the most -- more than 10 percent. The mechanization of cotton production and harvesting continued to advance rapidly. For example, more than three-fourths of the crop is now harvested mechanically. Farm output per man-hour rose almost 9 percent from 1963 to 1964 in the Delta region and 6 percent or more in the 3 other Southern regions. In the



Corn Belt, the index remained at the 1963 level of 147 percent of the 1957-59 average while modest gains were made in the remaining 5 regions.

In 1964, the average farmworker produced enough food, fiber, tobacco, and other products to supply himself and over 32 other people. This is more than 8 times as many consumers per farmworker as in 1820. In addition, farm commodities supplied consumers now have higher quality and greater variety than in earlier years. The long-term increase in consumers per farmworker has taken place at an ever-increasing rate. During the century ending in 1940, the average farmworker supplied products for an additional person each 27 years. During the 1940's, a consumer was added each two-year period. Since 1950, there has been more than an additional consumer yearly.

### C. Economics of Farm Labor Utilization

A project on labor and capital in selected crops and areas in California is underway in cooperation with the California Agricultural Experiment Station. The first area studied was Kern County, and two reports on it were released during the year. The second area was Stanislaus County, the leading county in the State in peach production. The field work was done over a one-year period, so as to cover the three major peaks of seasonal labor use: Peach harvest, tomato harvest, and peach thinning. Peaches have a peak harvest labor requirement of 7,000 to 9,000 workers. Seasonal labor needs for tomatoes, grapes, apricots, and berries add to the work year for some of the workers. Of the 905 workers surveyed, farm employment in 1962-63 averaged 128 days. This figure includes 26 days of nonfarm work. This is about half-time employment. From December through April, not more than 40 percent of the workers had employment. For the 128 days of work in 1962-63, the workers received an average of \$1,302--\$1,004 from farmwork and \$298 from nonfarm employment. These averages include data for Braceros or Mexican contract workers. Domestic workers had more days of work and greater earnings than the average of all workers. Data on days worked, tasks, earnings, and other pertinent characteristics by different worker classifications are presented in a cooperative report to be published by the University of California and this Division.

A study of factors affecting the demand for farm labor is being carried out cooperatively with the Iowa Agricultural Experiment Station. The study is an attempt to develop estimates of the demand relations for farm labor through the use of regression estimation procedures. An analysis of national time-series data is being carried out covering the period from 1938-62, and a regional analysis is being conducted for the 10 farm production regions covering the period 1940-62. Additionally, a cross-sectional analysis was completed using State data for selected years and developing farm labor migration functions and farm labor demand functions. This is being done for the years 1953, 1958, 1960, 1961, and 1962.



A report, "Technology, Automation, and Economic Progress in Agriculture" was prepared at the request of the National Commission on Automation, Technology, and Economic Progress. The manuscript, which is being reviewed in USDA before submission to the Commission, indicates that the rapid adoption of mechanization and other technology has resulted in a great decrease in farm labor despite a significant increase in production. It indicates also that these trends are expected to continue, which will intensify labor dislocation both geographically and occupationally. Renewed emphasis will be required on remedial programs such as an effective system of matching jobs with the jobless, a comprehensive and continuing program of determining job needs, and an effective information program that reaches all rural people to inform them, for example, of training and employment opportunities.

#### D. Economic Relationships Between Farm Operators and Hired Workers

A manuscript has been completed on the study of the feasibility of alternative methods of providing housing for migrant farmworkers. The study is cooperative with the Oregon Agricultural Experiment Station. Growers, camp operators, and workers in four areas in Oregon were included in the sample. Seventy-four of the 103 camps in the study provided housing for families only, five housed single workers only, and 24 provided housing for both. A third of the migrant workers interviewed started from California and the next largest part came from Texas. A majority were Anglo-American, but a fourth were Spanish-American. Most growers in the sample provided on-farm housing for at least part of their seasonal workers. The exception was in Malheur County where the majority of growers used workers from off-farm housing, much of it in grower-sponsored central camps.

From the enactment of Public Law 78 in 1951 to its termination on December 31, 1964, the Bracero program was the chief source of foreign farm labor in the United States. Its expiration caused concern in agriculture and in related segments of the economy over possible subsequent effects. An economic appraisal was conducted, and a report published, on the effects that termination of the Bracero program would have on the 1965 farm labor situation and migrant worker housing needs. The estimated number of Bracero replacements needed for peak work periods of 1965, after allowing for maximum possible replacement of workers by increased mechanization and other technology, is about 45,000 to 50,000 for the California fruit and vegetable harvest; 11,000 for the Michigan cucumber harvest; 5,000 to 6,000 for harvesting vegetables and citrus in Arizona; and up to 5,000 for harvesting vegetables in Texas. Little additional housing will be required if Braceros can be replaced by (1) workers from the local labor force, or (2) single workers for which existing foreign-worker housing would suffice. If Braceros are replaced to the maximum possible by technology and then by migrant families, the estimated additional number of persons requiring housing after conversion of foreign-worker housing is from 1,500 to 6,500 in California; 1,000 to 3,000 in Michigan; and about 600 in Arizona.

PUBLICATIONS - USDA AND COOPERATIVE PROGRAM

A. Farm Labor Requirements and Use

Farm Production Economics Division. 1965. Man-hours of labor used for farmwork, by groups of livestock and crops, for each farm production region, 1939-63. USDA Statistical Bul. No. 233, Supplement III. 12 pp.

Gavett, E. E. 1965. Truck crop production practices--Berrien and Van Buren Counties, Michigan. ERS-206. 49 pp.

Gavett, E. E. 1965. Truck crop production practices--Erie County, New York. ERS-207. 31 pp.

B. Farm Labor Productivity and Efficiency

Farm Production Economics Division. 1965. Changes in farm production and efficiency. USDA Statistical Bul. 233, revised. 37 pp.

Farm Production Economics Division. 1965. Index numbers of farm production per man-hour, by groups of livestock and crops, for each farm production region, 1939-63. USDA Statistical Bul. No. 233, Supplement IV. 12 pp.

C. Economics of Farm Labor Utilization

Metzler, W. H. 1964. The farmworker in a changing agriculture. California Agricultural Experiment Station, Giannini Foundation. Research Report No. 277. 98 pp.

Metzler, W. H. 1965. Farm mechanization and labor stabilization. California Agricultural Experiment Station, Giannini Foundation. Research Report No. 280. 58 pp.

D. Economic Relationships Between Farm Operators and Hired Farmworkers

McElroy, R. C. and Gavett, E. E. 1965. Termination of the Bracero program: some effects on farm labor and migrant housing needs. AER 77. 29 pp.

## Line Project Check List -- Reporting Year Sept. 1, 1964 to Sept. 1, 1965

| Work &<br>Line<br>Project<br>Number | Work and Line Project Titles   | Work Locations<br>During Past Year                                      | Line Proj. Incl. in       |                      |
|-------------------------------------|--|---|---------------------------|----------------------|
|                                     |  |   | Summary<br>of<br>Progress | Area &<br>Subheading |
| FE 1                                | Farm capital, credit, and financial condition  |   |                           |                      |
| FE 1-3                              | Operations of financial institutions that extend short-<br>and intermediate-term credit to farmers       | Washington, D.C.  | No                        | ---                  |
| FE 1-4                              | Savings and investments of farm operators  | Washington, D.C.<br>& East Lansing,<br>Mich.                            | Yes                       | 4-A                  |
| FE 1-5                              | Agricultural finance outlook   | Washington, D.C.  | Yes                       | 4-A                  |
| FE 1-7                              | Cost, terms, and availability of credit for rural housing  | Washington, D.C.<br>& Columbia, Mo.                                     | Yes                       | 4-B                  |
| FE 1-10<br>(Super-<br>sedes         | Financial management of farm firms   | Washington, D.C.  | Yes                       | 4-C                  |
| FE 1-8 &<br>FE 1-9)                 |  | Madison, Wis.,<br>East Lansing,<br>Mich. &<br>Urbana, Ill.              |                           |                      |
| FE 1-11<br>(Super-<br>sedes         | Maintenance and improvement of farm credit statistics<br>and analysis of trends                          | Washington, D.C.  | Yes                       | 4-B&C                |
| FE 1-1 &<br>FE 1-2)                 |  |   |                           |                      |
| FE 2                                | Farmland values and valuation  |   |                           |                      |
| FE 2-1<br>(Rev.)                    | Current developments in the farm real estate situation   | Washington, D.C.  | Yes                       | 7-A&B                |
| FE 2-2                              | Annual estimates and analysis of trends in farm real<br>estate rentals                                   | Washington, D.C.  | Yes                       | 7-C                  |
| FE 3                                | Agricultural risks and insurance   |   |                           |                      |
| FE 3-4                              | Risk and risk-bearing in selected agricultural areas   | Washington, D.C.,<br>Bozeman, Mont.<br>& Manhattan,<br>Kans.            | Yes                       | 5-D                  |
| FE 3-5<br>(Super-<br>sedes          | Measurement and analysis of farm losses and farm<br>insurance  | Washington, D.C.  | Yes                       | 5-A, B&C             |
| FE 3-1,<br>FE 3-2 &<br>FE 3-3)      |  |   |                           |                      |
| FE-0-0-1<br>(FCIC)                  | Economic impacts of Federal crop insurance   | Washington, D.C.<br>& Bozeman, Mont.                                    | No                        | ---                  |
| FE 9                                | Agricultural adjustments and production response   |   |                           |                      |
| FE 9-1                              | Economic evaluation of forage production and utiliza-<br>tion in New Hampshire                           | Durham, N. H.   | Yes                       | 2-A                  |
| FE 9-2<br>(Rev.)                    | A study of farm organization and management problems in<br>southeastern and southwestern Minnesota       | St. Paul, Minn.   | Yes                       | 2-A                  |
| FE 9-4                              | An economic evaluation of changes in use of farmlands<br>within Wisconsin watershed projects             | Madison, Wis.   | Yes                       | 2-B                  |
| FE 9-5<br>(Rev.)                    | Economics of adjustments in beef production in the west  | University Park,<br>N. Mex., Ft.<br>Collins, Colo.,<br>& Lincoln, Nebr. | Yes                       | 1-G                  |
| FE 9-7                              | Economics of adjustments in cotton producing areas in<br>California                                      | Davis, Calif.   | Yes                       | 1-D                  |
| FE 9-8                              | Adjustments in the economy of the Belle Fourche area<br>and analysis of Newell Field Station experiments | Newell, S. Dak.   | Yes                       | 1-G                  |

\*Initiated during reporting year. \*\*Discontinued during reporting year.



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| Work &<br>Line<br>Project<br>Number | Work and Line Project Titles   | Work Locations<br>During Past Year                            | Line Proj.                | Incl. in             |
|-------------------------------------|--|---|---------------------------|----------------------|
|                                     |  |   | Summary<br>of<br>Progress | Area &<br>Subheading |
| FE 9-9                              | An economic appraisal of adjustment opportunities in southern rice producing areas   | Fayetteville, Ark., Baton Rouge, La., & College Station, Tex. | Yes                       | 1-F                  |
| FE 9-10                             | Effects of alternative levels of grazing fees and privileges on ranch organization and net returns in public land areas**            | Washington, D.C. & selected States                            | No                        | ---                  |
| FE 9-11                             | Adjustments in hog and beef cattle production in the Corn Belt to meet changing conditions--FE cooperation in Regional Project NC-54 | Washington, D.C. & selected States                            | Yes                       | 1-G & 4-C            |
| FE 9-12                             | Economic appraisal of soil, water and crop practices on farm and ranch lands in the 17 western States**                              | Ft. Collins, Colo.  | No                        | ---                  |
| FE 9-13                             | An economic appraisal of boll weevil damage and alternative methods of control**   | Washington, D.C. & selected States                            | No                        | ---                  |
| FE 9-14                             | Economic appraisal of adjustments in Corn Belt farming to meet changing conditions   | Washington, D.C. & selected States                            | Yes                       | 1-G                  |
| FE 9-15                             | Economic appraisal of adjustments in dairy farming in the Lake States and adjoining areas to meet changing conditions                | Washington, D.C. & selected States                            | Yes                       | 1-C                  |
| FE 9-16                             | Economic appraisal of adjustments in dairy farming in the Northeast to meet changing conditions                                      | Washington, D.C. & selected States                            | Yes                       | 1-C                  |
| FE 9-17                             | Economics of adjustments on farms and production response in the Northern Plains wheat producing region                              | Washington, D.C. & selected States                            | Yes                       | 1-E                  |
| FE 9-18                             | Production economics studies of agricultural production control programs   | Washington, D.C. & selected States                            | Yes                       | 1-H                  |
| FE 9-19                             | Analysis of agricultural production response   | Washington, D.C. & selected States                            | Yes                       | 1-B                  |
| FE 9-20                             | Economic appraisals of emerging technological developments in southern agriculture   | Washington, D.C. & selected States                            | Yes                       | 2-A&B                |
| FE 9-21                             | An economic appraisal of emerging crop, livestock, and poultry technologies in the northern region                                   | Washington, D.C. & selected States                            | Yes                       | 2-A                  |
| FE 9-22                             | An economic appraisal of farming adjustment opportunities in the southeastern region to meet changing conditions                     | Washington, D.C. & selected States                            | Yes                       | 1-D                  |
| FE 9-23                             | Economics of adjustments on farms and production response in the Southern Plains wheat producing region                              | Washington, D.C. & selected States                            | Yes                       | 1-E                  |
| FE 9-24                             | Economics of adjustments on farms and production response in the Pacific Northwest wheat producing region                            | Washington, D.C. & selected States                            | Yes                       | 1-E                  |
| FE 9-25                             | Farm management under conditions of variable output in the Great Plains  | Bozeman, Mont.  | No                        | ---                  |
| FE 9-26                             | An economic appraisal of business survival probabilities of farms and ranches in the Great Plains area of Oklahoma                   | Stillwater, Okla.   | Yes                       | 2-A                  |
| FE 9-27                             | An economic appraisal of farming adjustment opportunities in the South Central region to meet changing conditions                    | Washington, D.C. & selected States                            | Yes                       | 1-D<br>2-A&B         |

\*Initiated during reporting year. \*\*Discontinued during reporting year.

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Line Project Check List -- Reporting Year Sept. 1, 1964 to Sept. 1, 1965

| Work &<br>Line<br>Project<br>Number | Work and Line Project Titles  | Work Locations<br>During Past Year                  | Line Proj. Incl.in        |                      |
|-------------------------------------|---|---|---------------------------|----------------------|
|                                     |   |   | Summary<br>of<br>Progress | Area &<br>Subheading |
| FE 9-28                             | Economic appraisal of regional adjustments in agricultural production and resource use to meet changing demand and technology | Washington, D.C. & selected States                  | Yes                       | 1-B                  |
| FE 9-29                             | Long term projections for the production of agricultural commodities in the Pacific Northwest**                               | Corvallis, Oreg.                                    | No                        | ---                  |
| FE 9-30                             | Economic analysis of production problems and adjustments on western range-livestock ranches                                   | Washington, D.C. & selected States                  | Yes                       | 1-G                  |
| FE 9-31                             | Appraisal of year-to-year changes in the cost of producing cotton in the U. S.*   | Washington, D.C.                                    | Yes                       | 1-I                  |
| FE 10                               | Economics of farm size  |   |                           |                      |
| FE 10-1<br>(Rev.)                   | Economic appraisal of minimum farm resources needed for specified farm income levels  | Washington, D.C. & selected States                  | No                        | ---                  |
| FE 10-2<br>(Rev.)                   | Classification and analysis of kinds and sizes of farms   | Washington, D.C.                                    | Yes                       | 3-B                  |
| FE 10-4                             | Optimum and feasible adjustments in size and number of farms in selected areas  | Washington, D.C. & selected States                  | Yes                       | 3-B                  |
| FE P-1                              | Pioneering research in vertical coordination  | Washington, D.C.                                    | Yes                       | 3-A                  |
| FE-ME 1                             | Changing structure and performance of the American agricultural chemical industry and its coordination with farms*            | Washington, D.C.                                    | Yes                       | 3-A                  |
| FE 11                               | Economics of farm labor resources and utilization   | Washington, D.C.                                    | Yes                       | 10-A                 |
| FE 11-1                             | Maintenance and improvement of annual estimates of labor requirements in American agriculture                                 |   |                           |                      |
| FE 11-2                             | Measurement and analysis of labor productivity and efficiency in American agriculture   | Washington, D.C.                                    | Yes                       | 10-B                 |
| FE 11-3                             | Labor and capital in selected crops and areas in California   | Washington, D.C. & Davis, Calif.                    | Yes                       | 10-C                 |
| FE 11-5                             | Economic and related aspects of providing housing for migrant hired farmworkers   | Washington, D.C. & Corvallis, Oreg.                 | Yes                       | 10-D                 |
| FE 12                               | Economics of technological changes in farming   |   |                           |                      |
| FE 12-1                             | Measurement and analysis of progress in farm mechanization  | Washington, D.C.                                    | No                        | ---                  |
| FE 12-2<br>(Rev.)                   | National survey and analysis of selected farm production practices  | Washington, D.C.                                    | Yes                       | 8-D                  |
| FE 12-3                             | Maintenance and improvement of annual estimates of feed consumption and animal units in the U. S.                             | Washington, D.C.                                    | Yes                       | 8-B                  |
| FE 12-6                             | Economic interpretation of yield response to fertilizer and associated technology   | Washington, D. C.                                   | Yes                       | 8-E                  |
| FE 12-7(C)                          | The farm demand for fertilizer, machinery, and structures   | Washington, D.C., Ames, Iowa, & East Lansing, Mich. | Yes                       | 8-C&F                |
| FE 12-9                             | Economic evaluation of pasture production   | Washington, D.C.                                    | No                        | ---                  |
| FE 12-10                            | Economics of pesticide use in agriculture*  | Washington, D.C., Lincoln, Nebr., & Davis, Calif.   | Yes                       | 8-A                  |
| FE 12-11                            | Estimates of principal plant nutrients used on specified crops*   | Washington, D.C.                                    | No                        | ---                  |

\*Initiated during reporting year. \*\*Discontinued during reporting year.

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Line Project Check List -- Reporting Year Sept. 1, 1964 to Sept. 1, 1965

| Work &<br>Line<br>Project<br>Number | Work and Line Project Titles   | Work Locations<br>During Past Year | Line Proj. Incl.in        |                     |
|-------------------------------------|--|------------------------------------|---------------------------|---------------------|
|                                     |  |                                    | Summary<br>of<br>Progress | Area &<br>Subheadin |
| FE 13                               | Farm output and resource productivity  |                                    |                           |                     |
| FE 13-1                             | Maintenance, improvement and analysis of overall measures of farm production   | Washington, D.C.                   | Yes                       | 1-A                 |
| FE 13-2                             | Measurement and analysis of changes in resources used, and efficiency of resource use, in agriculture                                  | Washington, D.C.                   | Yes                       | 1-A                 |
| FE 13-3                             | Appraisal of the influence of weather on crop yields and production  | Washington, D.C.                   | Yes                       | 1-A                 |
| FE 13-4                             | Appraisal of farm production prospects and resource needs  | Washington, D.C.                   | Yes                       | 1-A                 |
| FE 14                               | Farm costs and returns   |                                    |                           |                     |
| FE 14-1<br>(Rev.)                   | Annual estimates and analyses of changes in costs, returns, and farm organization on commercial family-operated farms by type and size | Washington, D.C.                   | Yes                       | 9-A                 |
| FE 14-2                             | Preparation of "Farm Cost Situation" reports   | Washington, D.C.                   | Yes                       | 9-A                 |
| FE 14-3<br>(Rev.)                   | Costs and returns on commercial poultry farms (egg and broiler) in the Northeastern, Middle Atlantic, and Southeastern States          | Washington, D. C.                  | Yes                       | 9-A                 |

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